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EPA Shawnee Field Evaluation
Third Annual Report

Aerospace Corp.
Los Angeles, CA

Prepared for

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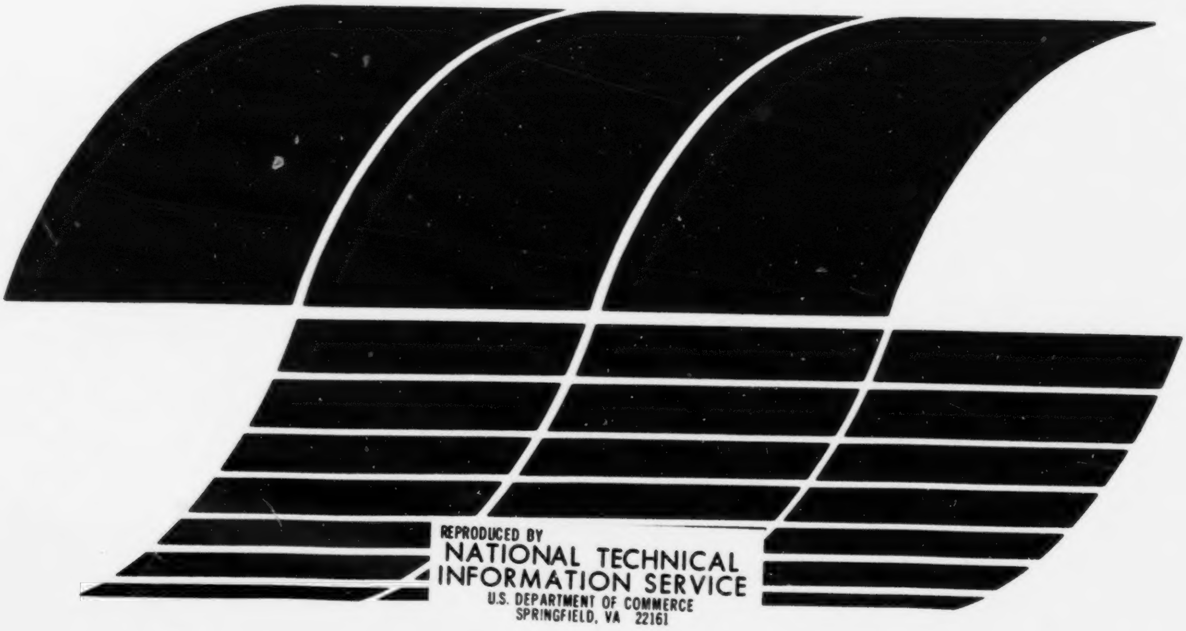

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The report describes progress made on a field evaluation project being conducted by the EPA to assess techniques for disposing of power plant flue gas cleaning (FGC) wastes. The evaluation site is at TVA's Shawnee steam plant in Paducah, KY. Two prototype scrubbers, using lime and limestone absorbents and rated at 10 MWe, produced the sludges used in the project. By mid-1978, eight ponds were being evaluated: two untreated, three chemically treated, and three untreated with underdrainage. One underdrained pond contains sulfite sludge which has been oxidized to sulfate (gypsum). Groundwater, supernate, leachate, underdrain, runoff, and sludge and soil cores are being analyzed. After 3 years, the wastes in two of the chemically treated ponds and the untreated ponds with underdrainage are exhibiting the ability to shed water and to control seepage, respectively, and to support construction vehicles. The chemically treated pond under water reduces sludge permeability by about 1 order of magnitude as do the others, and provides strength but not traction for vehicles. Gypsum dewaters and handles easily, but its runoff and leachate must be controlled to prevent discharge to water supplies. It becomes structurally unstable when rewet; however, the disposal site can be managed to prevent these conditions.

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Cleaning			13H	
Calcium Oxides			07B	
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ABSTRACT

This interim document is the third annual progress report made on a field evaluation project being conducted by the U.S. Environmental Protection Agency to assess techniques for the disposal of power plant flue gas desulfurization wastes. It discusses the results obtained from September 1974, when the project was initiated, through June 1978. The evaluation site is at the TVA Shawnee Steam Plant in Paducah, Kentucky. Two prototype scrubbers, using lime and limestone absorbents and rated at 10-MWe each, produced the sludges used in this project. By mid-1978, eight ponds were under evaluation. Two are untreated, three are chemically treated, and three are untreated with underdrainage. One of the underdrained ponds contains sludge which has been oxidized to gypsum. Groundwater, supernate, leachate, underdrain, runoff, and sludge and soil cores are being analyzed.

After three years, two of the chemically treated ponds and the untreated ponds with underdrainage exhibit the ability to shed water and to control seepage, respectively, and to support construction vehicles. The chemically treated pond under water reduces sludge permeability by about one order of magnitude, as do the others, and provides strength but not traction for vehicles. Gypsum dewaters and handles easily, but its runoff and leachate must be controlled to prevent discharge to water supplies. It becomes structurally unstable when rewet; however, the disposal site can be managed to prevent these conditions.

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To Convert from English Units	To Metric Units	Multiply by
Acres	Square Meters	4047
Acre-Feet	Cubic Meters	1234
Btu	Joules	1054
Btu per Hour	Watts	0.2929
Cubic Feet	Cubic Meters	0.02832
Cubic Yards	Cubic Meters	0.7646
Feet	Meters	0.3048
Feet per Minute	Meters per Second	0.005080
Feet per Second	Meters per Second	0.3048
Foot-Pounds	Joules	1.356
Foot-Pounds per Minute	Watts	0.02260
Gallons	Cubic Meters	0.003785
Horsepower (Electric)	Watts	746.0
Inches	Meters	0.02540
Miles per Hour	Meters per Second	0.4470
Miles	Meters	1609
Pounds	Kilograms	0.4536
Pounds	Newtons	4.448
Pounds per Cubic Feet	Kilograms per Cubic Meter	16.02
Pounds per Square Inch	Newtons per Square Meter	7031
Square Feet	Square Meters	0.09290
Square Yards	Square Meters	0.8361
Tons (Short)	Kilograms	907.2
Yards	Meters	0.9144

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SECTION I

INTRODUCTION

This project was initiated in September 1974 by the U.S. Environmental Protection Agency (EPA) for the purpose of conducting a field disposal evaluation of throwaway by-products from nonregenerable flue gas desulfurization (FGD) systems. The purpose of this project is to evaluate the effects of various disposal techniques, scrubbing operations, weather, soil interactions, and field operation procedures on the environmental quality of the disposal site to determine environmentally sound methods of disposal. Principal interest is in water quality and land reclamation associated with disposal by ponding and landfilling; therefore, periodic sampling, analyses, and assessments of leachate, supernate, runoff, groundwater, and soil and sludge cores are conducted. The project is expected to continue through 1980.

Currently, eight field disposal sites are being evaluated in this project. Each pond containing FGD sludge from lime and limestone scrubbers was excavated in a silty clay field approximately 45 ft above the water table. At a depth beyond 20 ft, some fine sand is present. Typical permeability of the clay material is about 5×10^{-7} cm/sec. Two contain untreated sludges; three contain chemically treated sludges; and three contain untreated sludges with underdrainage, the last of which contains a sulfite sludge which has been oxidized to gypsum, filled to capacity, and then piled above grade. All the sludges contain about 40 wt% fly ash except two which are relatively ash-free, viz., the lime with underdrainage and the gypsum site. This report discusses the first 3-1/2 years of work, encompassing all effort on these ponds. The addition of two gypsum sites, not ponded but piled above grade, and the planting of young trees on two closed ponds (of the original eight) subsequent to this reporting period will complete the configuration of the project.

The disposal sites are located at the Tennessee Valley Authority (TVA) Shawnee Steam Plant near Paducah, Kentucky. Two different scrubber systems, functioning in parallel, are being operated at this station as an EPA/TVA test facility. Each of the scrubbers [a turbulent contact absorber (TCA) and a venturi followed by a spray tower] is capable of treating up to 10 megawatt equivalent (MWe) of flue gas. Sludges from these scrubbers using lime and limestone as the sulfur dioxide (SO_2) absorbent are used in the disposal evaluation project. This program provides a broad data base for the evaluation of SO_2 control through concurrent evaluations of scrubber performance, sludge disposal, and laboratory analyses.

Engineering cost estimats for various chemical treatment disposal methods were discussed in detail in the initial report (Ref. 1). These estimates are updated in this report, and a review of current disposal cost estimates for ponding of untreated sludge and gypsum sludge is presented.

This is the third report to be issued on this project. The first two reports (Refs. 1 and 2) discussed the results obtained on the project from September 1974 through October 1976. This report contains the data and results of analyses generated from September 1974 through June 1978. Some updates have been made for clarity during the publication period.

The effort reported on in this document is part of a broad range of FGD waste disposal study activities by EPA, the results of which have been described in other Aerospace reports (Refs. 3 through 5). The most recent of these reports (Ref. 4) provides the results of the chemical characterization and physical properties analyses for untreated and chemically treated sludges from 13 different scrubbers at Eastern and Western power plants using lime, limestone, or double-alkali absorbents. The data given in this document are oriented toward the specific activities at the TVA Shawnee Plant, but where appropriate, references are made to relate this work to the general field of FGD waste disposal.

SECTION II

FINDINGS

After the third year of this field evaluation project, the following findings appear to be significant:

a. Pond C, containing IUCS chemically treated sludge, is structurally sound and has demonstrated the ability to shed water and prevent seepage (after conversion to a runoff configuration in early 1979). The underdrainage of untreated sludge (Ponds F and G) results in a structurally sound material in an impoundment and all seepage and rainfall at the sites are controlled. (Operationally, these waters would be returned to the scrubber for reuse.) Pond B, containing a Dravo chemically treated sludge which can be disposed of under water, supports wheeled construction vehicles but does not afford traction. Chemical treatment improves the coefficient of permeability by at least one order of magnitude.

b. The concentration of total dissolved solids (TDS) in the leachate of the chemically treated and untreated waste in nondrained ponds has approached levels that approximate saturation with gypsum.

c. The groundwaters associated with all ponds show no effect atributable to chemically treated or untreated waste disposal.

d. Runoff from sulfite sludge that has been force-oxidized to gypsum shows a TDS concentration of between 2500 and 3200 mg/ℓ, and the total suspended solids (TSS) in the same runoff varies between 4 and 300 mg/ℓ. For structural strength to be maintained in the gypsum material, the site should be managed to shed water so that it is not allowed to reslurry by wetting.

e. Concentrations of trace elements being monitored in the leachate of chemically treated sludges show positive and negative variations from concentrations in the input liquor. Concentrations greater than input conditions can result from additional trace elements present in the chemicals added in the treatment process (e.g., cement, fly ash, and lime). Of several thousand analyses of treated and untreated sludge leachate, only two showed trace element concentrations greater than 10 times the allowable in drinking water (i.e., one selenium and one cadmium case), and these were in the range of 10 to 20 times the allowable.

f. Pond closure by draining, covering, and contouring with clay material has been demonstrated to be sufficient to retire disposal sites (chemically treated Pond E and untreated, underdrained Pond F) so that they will support construction vehicles and shed water, thereby preventing seepage.

SECTION III

RECOMMENDATIONS

It is recommended that the following specific disposal techniques be further evaluated:

a. Continued investigation of the disposal of force-oxidized sulfite sludge (gypsum) including those processes in which organic additives are used in the scrubbing process. This investigation should include the effects of weathering, quality of runoff waters, and structural properties. This is needed because there is a desire by some utilities to dispose of gypsum filter cake by stacking it as high as 100 ft and letting it remain permanently. Preliminary investigations have indicated that the material suffers from the effects of freeze-thaw and wet-dry cycling, which produces cracks and thereby allows rainfall to enter the material. As a result, rewetting occurs and causes a certain reduction of the strength of the material, while the concurrent runoff contains sediment and dissolved solids not allowable in discharge to streams. If this practice is followed, methods to do so in an environmentally sound manner need to be determined.

b. Monitoring of closed disposal sites containig both chemically treated and untreated, underdrained waste to evaluate the ability of these sites to support tree growth and to determine the effects of closure and tree plantings on seepage and subsidence at the respective sites. No demonstrations have been made to verify the ability of a capped disposal site to support deep rooted growth and to prevent seepage and subsidence.

c. Continued evaluation of the effects of time and weather on the structural and chemical characteristics of chemically treated sludges. After several years of monitoring chemically treated sludges at the Shawnee site, deterioration (cracking and flaking) of the surfaces has occurred as a result of weathering. The extent to which this occurs and the depth at which it might be effective need to be determined with respect to as long a time as possible.

d. Continued evaluation of seepage and the quality of runoff from a pond containing chemically treated waste in which the runoff mode simulates an operational disposal configuration. A limestone/fly ash treated site (Pond C) at Shawnee contains hairline cracks due to shrinkage during the curing cycle. This site has been operating as a worst case condition in which rainwater is trapped and contained on the surface. As a result, seepage through the hairline cracks reach the base of the pond rapidly. The purpose of the conversion of this pond to a runoff mode is to determine whether this material is capable of shedding rainfall such that seepage to the base is prevented.

e. Disposal of sludges produced from new scrubber installations or processes being tested at the TVA Shawnee Scrubber Test Facility. Because all sludges are unique regarding the sources of materials and type of processes in which they are produced, any new sludges that are different from those already evaluated may well exhibit properties not observed previously. A disposal evaluation of these materials would be advisable.

SECTION IV

SUMMARY

The FGD field evauation project was initiated in September 1974 at the TVA Shawnee Steam Plant in Paducah, Kentucky, for the purpose of assessing techniques and field operating procedures for the disposal of nonregenerable FGD system wastes. At the time of this report, eight disposal impoundments (ponds) were being evaluated. A data summary of the sludge types in the respective ponds is shown in Table 1. Three ponds contain sludge that has been chemically treated, and the remaining five ponds contain untreated sludge, two in open ponds and three in ponds equipped with underdrain systems. The chemical treatment processes are described in Ref. 1, and the underdrain construction and operation are described in Section VI of this report.

All ponds are being monitored for the quality of the leachate and groundwater. Depending on the configuration of the pond, the supernate, runoff and/or underdrain water are also being monitored. In addition, sludge cores are evaluated for those ponds containing chemically treated material, and soil cores are analyzed from both treated and untreated ponds for comparison with virgin soil. The significant results and trends observed to date are summarized in the following paragraphs.

4.1 UNTREATED SLUDGE

4.1.1 Leachate and Underdrain

The leachates of Ponds A/A1 and D, as reported in Ref. 4, showed a rapid increase in the concentration of total dissolved solids (TDS) and dissolved constituents immediately after pond filling. These concentrations increased steadily, reaching peak values close to those in the input liquor of the respective ponds. The peak concentrations would have appeared initially except the leachate was diluted by rainwater that was in the leachate well and on the pond bottom when the project was initiated. This is true for all ponds that had leachate wells except for Pond C, whose well was drained prior to initiation of monitoring. Starting in July 1976, all leachate wells were evacuated after each sampling. Since that time the TDS has steadily decreased, and after 3-1/2 years has leveled off in both ponds at a concentration of approximately 2300 mg/ℓ (Figures 1 and 2). The chloride has been virtually depleted in both ponds, leaving calcium sulfate as the prime dissolved constituent. Six selected minor species are being monitored in both ponds. The results show that in Pond A/A1 the concentration of boron, lead, selenium,

TABLE 1. SHAWNEE DISPOSAL SITES

Site	Fill Date	Scrubber Type[a]	Sludge		Solids[c] Content (wt %)	Treatment	Remarks
			Absorbent	Source[b]			
A	10/8/74	VST	Lime	F	46	Untreated	Out of service 4/15/76
A1	5/10/76	VST	Lime	F	46	Untreated	Control pond, transferred from Pond A
B	4/15/75	TCA	Limestone	CU	38[d]	Dravo	Underwater disposal
C	4/23/75	VST	Lime	CE	55[d]	IUCS	Pond converted to runoff mode 3/79
D	2/5/75	TCA	Limestone	CU	38	Untreated	Control pond
E	12/7/74	TCA	Limestone	CU	38[d]	Chemfix	Closed 11/77
F	2/3/77	TCA	Limestone	CU	47	Untreated	Underdrained pond, closed 11/77
G	10/5/76	VST	Lime	CE	47	Untreated	Underdrained pond
H[e]	9/2/77	VST	Limestone	CU	33	Untreated	Pond
	9/30/77	VST	Limestone	F	86	Untreated	Surface site, unreacted limestone 13% dry wt

[a] Venturi and spray tower (VST); turbulent contact absorber (TCA).

[b] Filter (F), clarifier underflow (CU), and centrifuge (CE).

[c] Pond H is ash-free. All others: fly ash is approximately 40 wt % of solids content.

[d] Prior to chemical treatment.

[e] Forced-oxidized to gypsum.

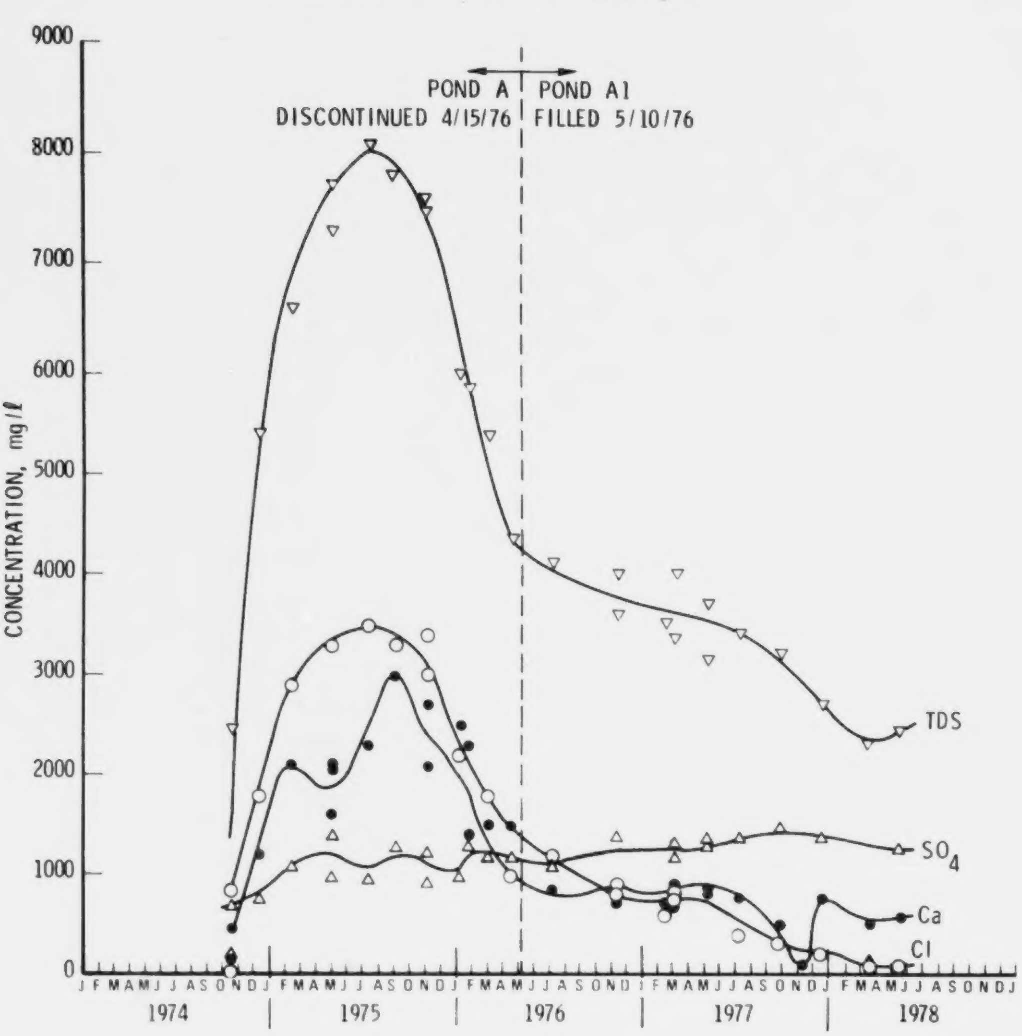


Figure 1. Concentration of TDS and major species in Pond A/A1 leachate

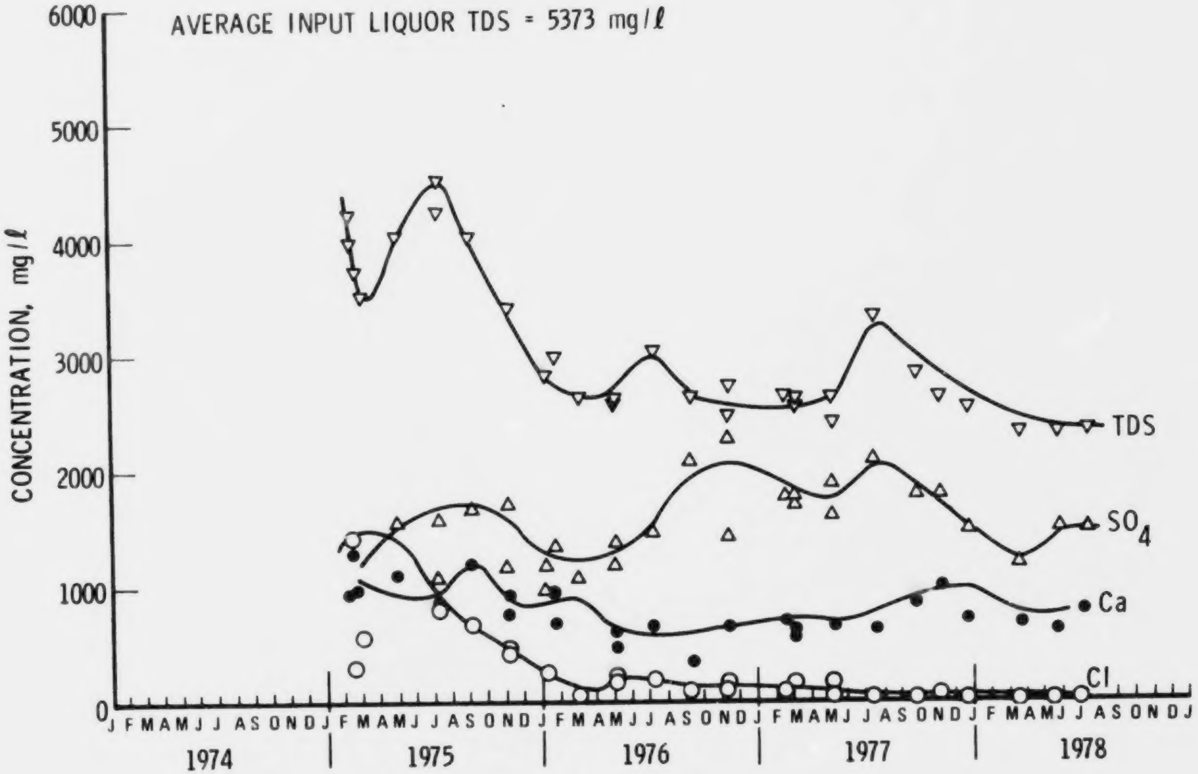


Figure 2. Concentration of TDS and major species in Pond D leachate.

and mercury have remained relatively constant and the concentrations of magnesium and arsenic declined gradually. In Pond D, the concentrations of arsenic, selenium, lead, and mercury remained constant, with magnesium and boron decreasing slightly.

The analyses of underdrain water from Ponds F, G, and H show a rapid decrease in the concentration of TDS and dissolved constituents, as compared to ponds not equipped with underdrain systems (Figures 1 and 3 through 5). It should be noted, however, that the addition of new material on the surface of any pond will result in concentrations in the leachate equal to the initial values. The six minor species monitored in the untreated sludges in Ponds F, G, and H have shown occasional variations.

4.1.2 Runoff

Runoff from ash-free gypsum filter cake on Pond H is being monitored. As of mid-1978 (10 months after pond filling), the TDS concentration has remained between 2500 and 3200 mg/ℓ (Figure 5). However, the total suspended solids (TSS) in the runoff has shown a wide variation, with values ranging between 4 and 309 mg/ℓ . This variation is to be expected as the crust of the filter cake material erodes from weathering and fresh material is periodically exposed to rainfall. A comparison of typical concentrations of major and selected minor species in the runoff and underdrain of the Pond H material (Table 2) shows chloride, TDS, boron, magnesium, selenium, sodium, and potassium to be higher in the underdrain water, whereas sulfate, arsenic, and lead are in higher concentrations in the runoff water.

4.1.3 Supernate

The concentrations of TDS and major constituents in the supernate of Ponds A1 and D have exhibited the characteristic seasonal variations expected as the quantity of water increases or decreases with rainfall (Figures 6 and 7). However, over a 3-1/2-year monitoring period, a gradual decrease in the maximum concentration of TDS and dissolved constituents has been observed, and by mid-1978 the maximum TDS concentration in the supernate of both ponds had dropped to less than 2000 mg/ℓ .

4.1.4 Groundwater

There have been no indications that the groundwater has been affected in any way by the untreated sludge material. The groundwater associated with Pond D consistently shows a somewhat higher concentration of chloride and TDS than the groundwater associated with the other disposal ponds. However, since only the chloride concentration has increased while calcium and sulfate have remained stable, it is assumed that this condition is not caused by the pond. Monitoring will be continued on this situation, however.

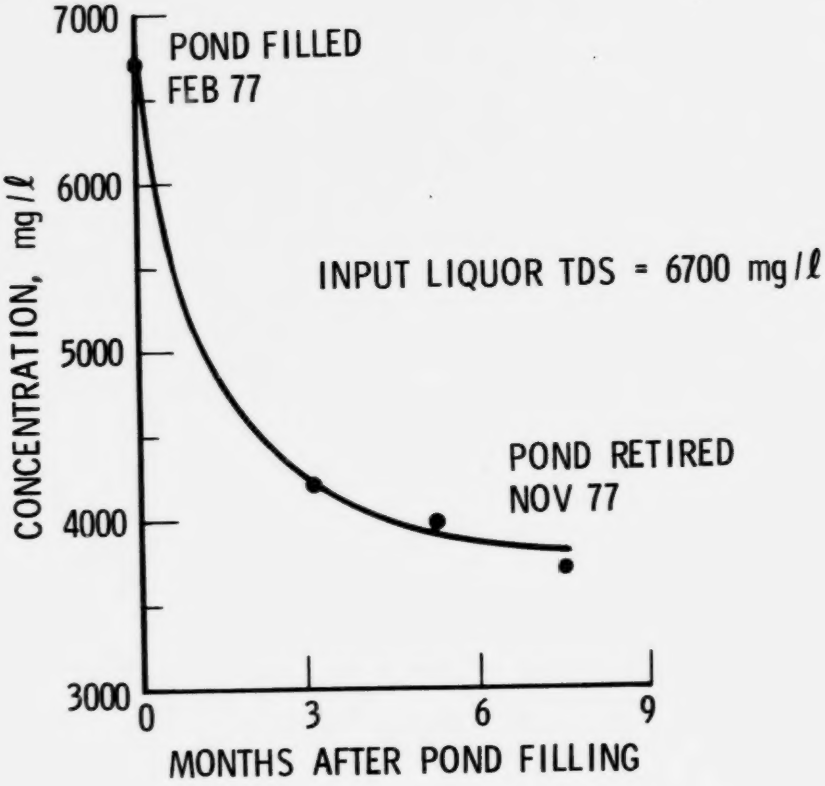


Figure 3. Concentration of TDS in Pond F underdrain.

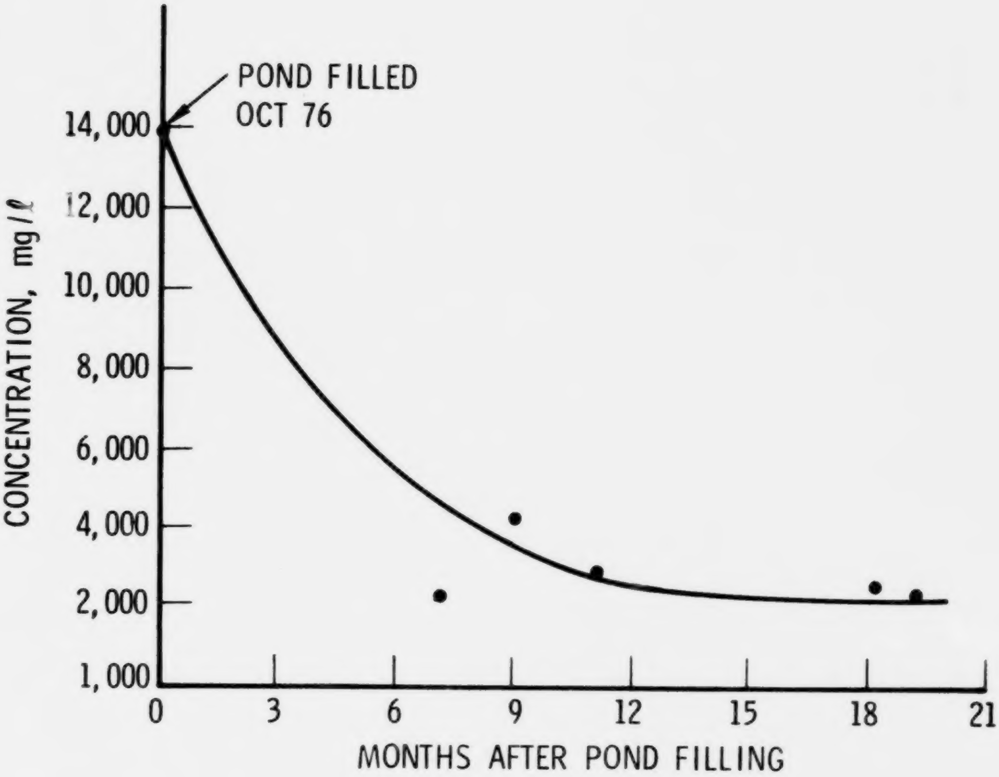
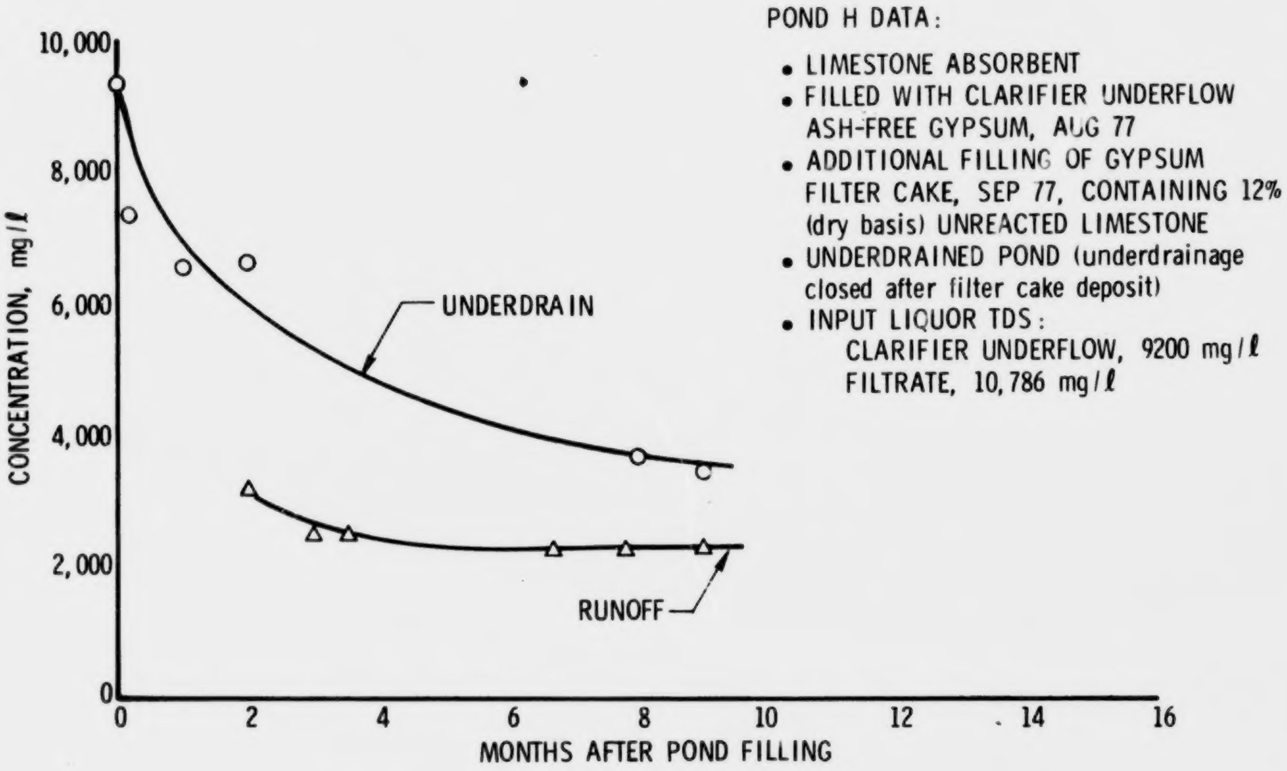


Figure 4. Concentration of TDS in Pond G underdrain.



POND H DATA:

- LIMESTONE ABSORBENT
- FILLED WITH CLARIFIER UNDERFLOW ASH-FREE GYPSUM, AUG 77
- ADDITIONAL FILLING OF GYPSUM FILTER CAKE, SEP 77, CONTAINING 12% (dry basis) UNREACTED LIMESTONE
- UNDERDRAINED POND (underdrainage closed after filter cake deposit)
- INPUT LIQUOR TDS:
  - CLARIFIER UNDERFLOW, 9200 mg/ℓ
  - FILTRATE, 10,786 mg/ℓ

Figure 5. Comparison of TDS concentration in the underdrain water and runoff of Pond H.

TABLE 2. SUMMARY OF TYPICAL CONCENTRATIONS OF MAJOR AND MINOR SPECIES IN POND H UNDERDRAIN AND RUNOFF SAMPLES[a]

Concentration in mg/ℓ

Species[a]	Underdrain	Runoff
Chloride	1300	7 to 500
Sulfate	1200	1400
Calcium	600	600
TDS	3500	2200
Arsenic	0.006	0.030
Boron	30	0.5 to 27.0
Lead	0.20	0.30
Magnesium	280	5 to 160
Mercury	0.0012	0.0015
Selenium	0.005	0.0004
Sodium	60	3.0
Potassium	30	3.0
Fluoride	2.0	2.3
TSS	Not measured[b]	4 to 309

[a] Sampled in March 1978, six months after placement of the material on the site.

[b] Results from TVA on duplicate samples in this time interval ranged from 130 to 720 mg/ℓ total suspended solids.

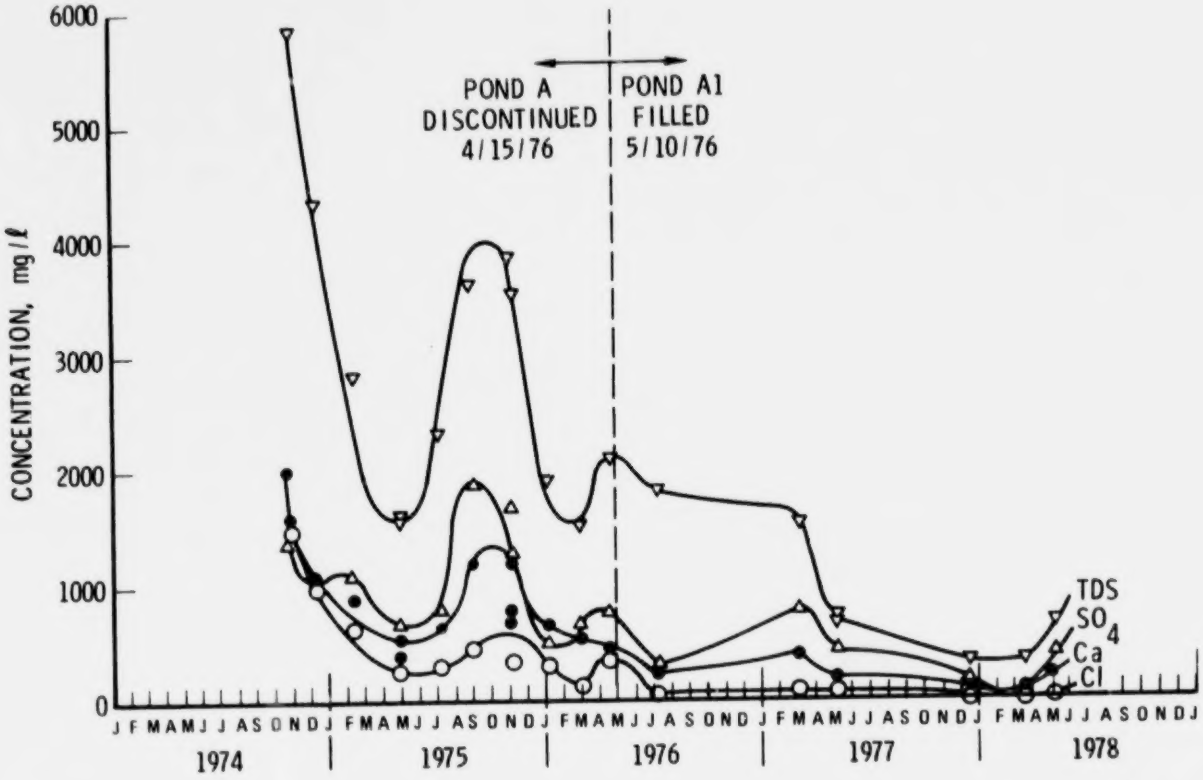


Figure 6. Concentration of TDS and major species in Pond A/A1 supernate.

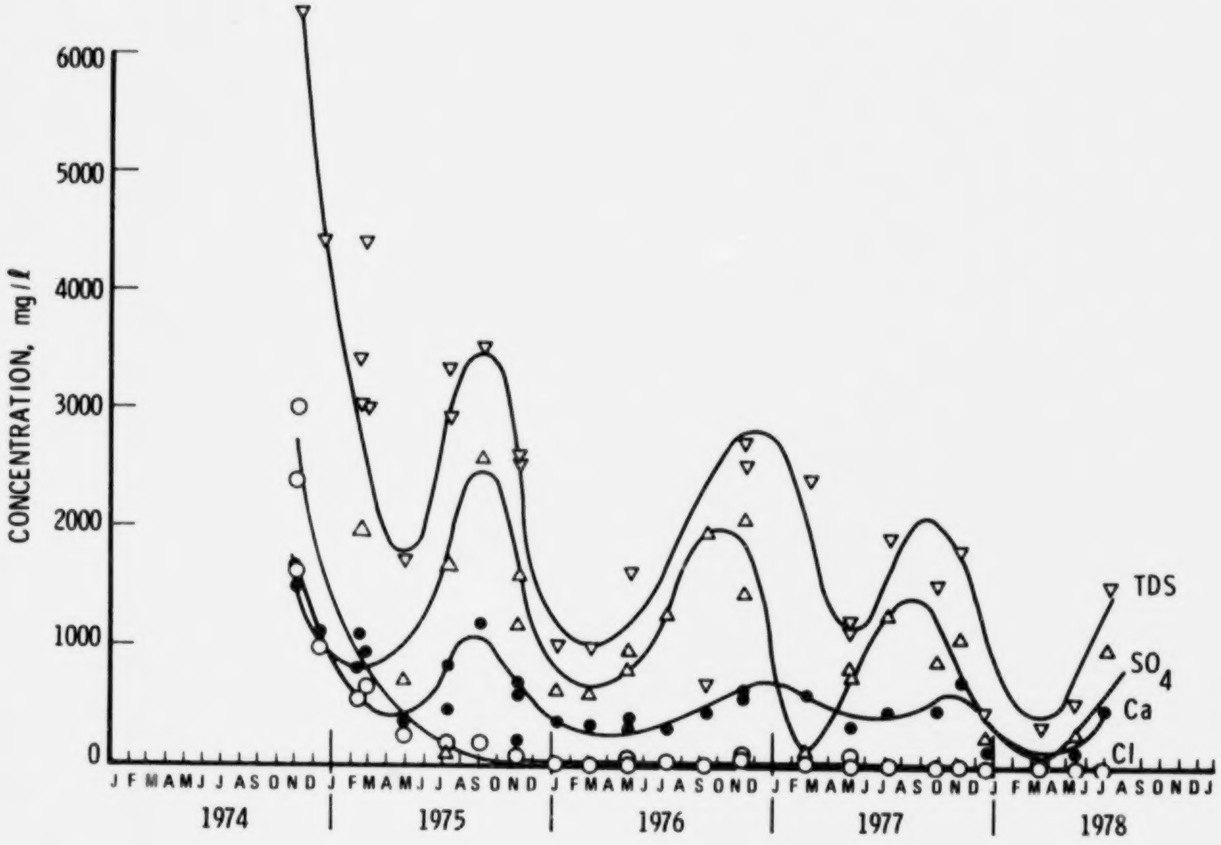


Figure 7. Concentration of TDS and major species in Pond D supernate.

4.1.5 Physical Characteristics

The physical characteristics considered in the disposal of FGD sludges are bulk density, water retention, bearing strength, porosity, permeability, and viscosity. Laboratory tests for all of these parameters have been conducted on Shawnee sludges and are discussed in Section 8.1.5 of this report. In addition, field measurements have been made on bearing capacities of untreated sludges in ponds containing underdrain systems; the results are shown in Table 3. The results for treated sludges are shown also for comparison purposes. These tests were all made with a field penetrometer (Soiltest, Inc., Model CN988), which measures bearing capacities between 10 and 450 psi (the field penetrometer measures the ultimate bearing capacity which is the maximum load per unit area that can be reacted by the material). The load-bearing strength of untreated sludges in undrained ponds has been too low to obtain accurate measurements, although occasionally Pond A1 will support personnel if the surface is free of supernate. The highest bearing capacity measured to date on untreated sludges, i.e., 330 psi or greater, was obtained on gypsum clarifier underflow in an underdrained pond. Lime sludge, underdrained, has shown bearing capacities in the range of 100 to 240 psi, and underdrained limestone sludges somewhat lower, in the range of 50 to 75 psi.

Laboratory tests on load-bearing strength as a function of moisture and fly-ash content have been conducted on sludges from various sources in addition to Shawnee; the results are shown in Figure 8, and the test procedure is given in Appendix B. All sludges have a critical solids content above which the strength increases rapidly and below which it decreases rapidly, as shown in the figure. After dewatering, the reason for preventing rewetting is obvious since only a few percentage points change results in a large loss of strength.

4.2 CHEMICALLY TREATED SLUDGE

4.2.1 Leachate

The leachates from the ponds containing chemically treated sludge have consistently exhibited a maximum TDS concentration of approximately half that of the input liquor to the respective ponds. In addition, three years after pond filling, the TDS concentrations in all three ponds containing chemically treated sludges have settled at a value of approximately 3000 mg/ℓ (Figures 9 through 11).

4.2.2 Supernate

The concentration of TDS and major constituents in the supernate of the chemically treated sludges has shown the characteristic fluctuations resulting from varying weather conditions (Figures 12 through 14). In all three ponds, the chloride has been virtually depleted within 1-1/2 to 2 years after pond filling. The peak TDS concentrations have typically been approximately one-half that of the input liquor to the respective ponds.

TABLE 3. SLUDGE ULTIMATE BEARING CAPACITY

Pond and Absorbent	Bearing Capacity, psi[a]		
	Distance Below Sludge Surface		
	1-2 in.	2-4 in.	4-6 in.
Pond B,[b,c] Lime	10-15	150	150-300
Pond C, Limestone[c]	150-330	240-300	330
Pond E, Limestone[c]	75-300	90-300	300-330
Pond F, Limestone	50-75	60-75	60-75
Pond G, Lime	100-150	100-150	180-240
Pond H, Gypsum[d]	330	330	>330
Soil (Shawnee, Clay)	60-100	120	240-300

[a] Data taken in August 1977 within 24 hr following a 3.3-in. rainfall.

[b] Pond B covered by 4 in. of water.

[c] Chemically treated.

[d] Tests for Pond H made on settled and drained clarifier underflow.

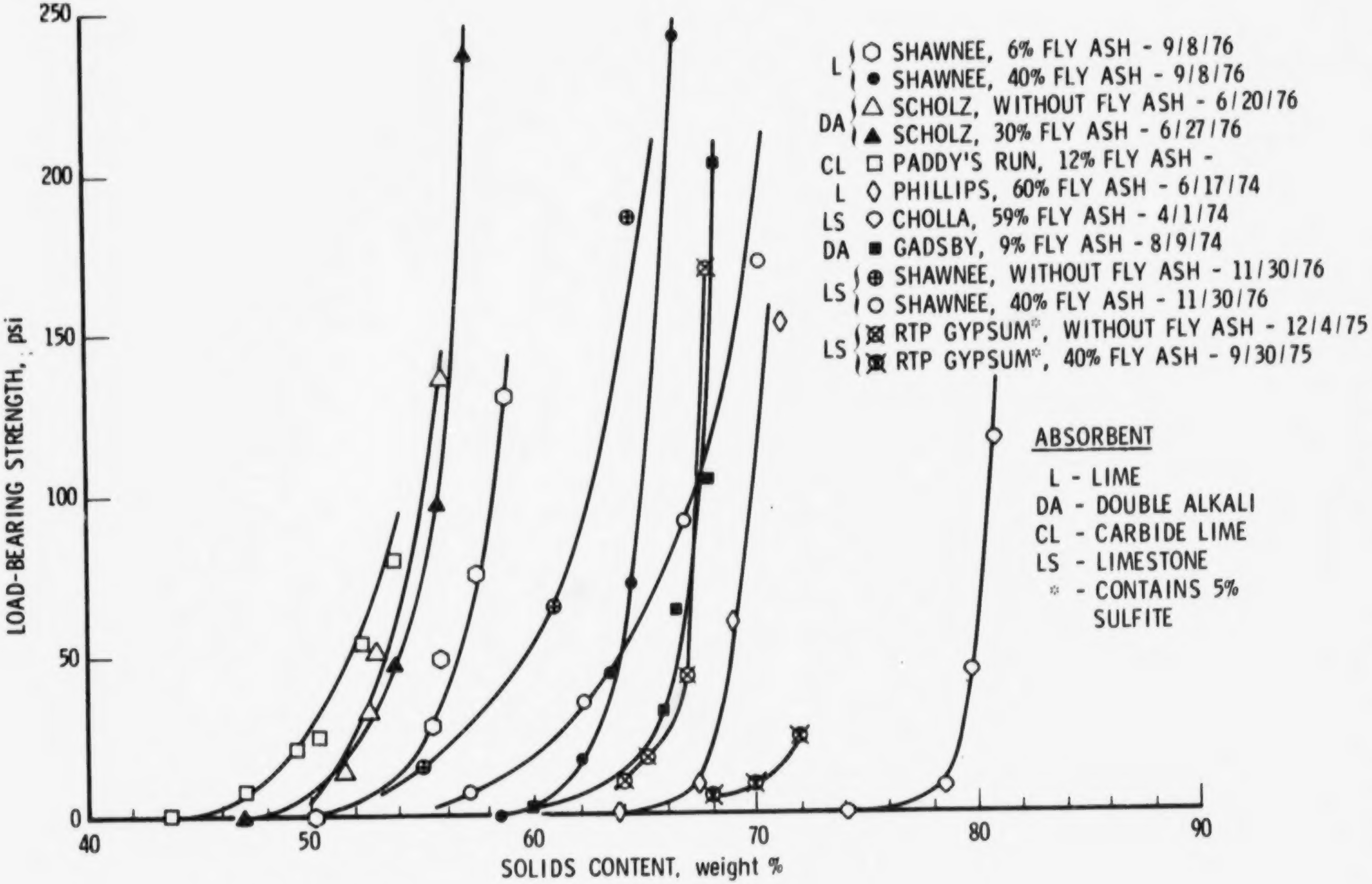


Figure 8. Load-bearing strength as a function of moisture, fly ash content, and sludge origin.

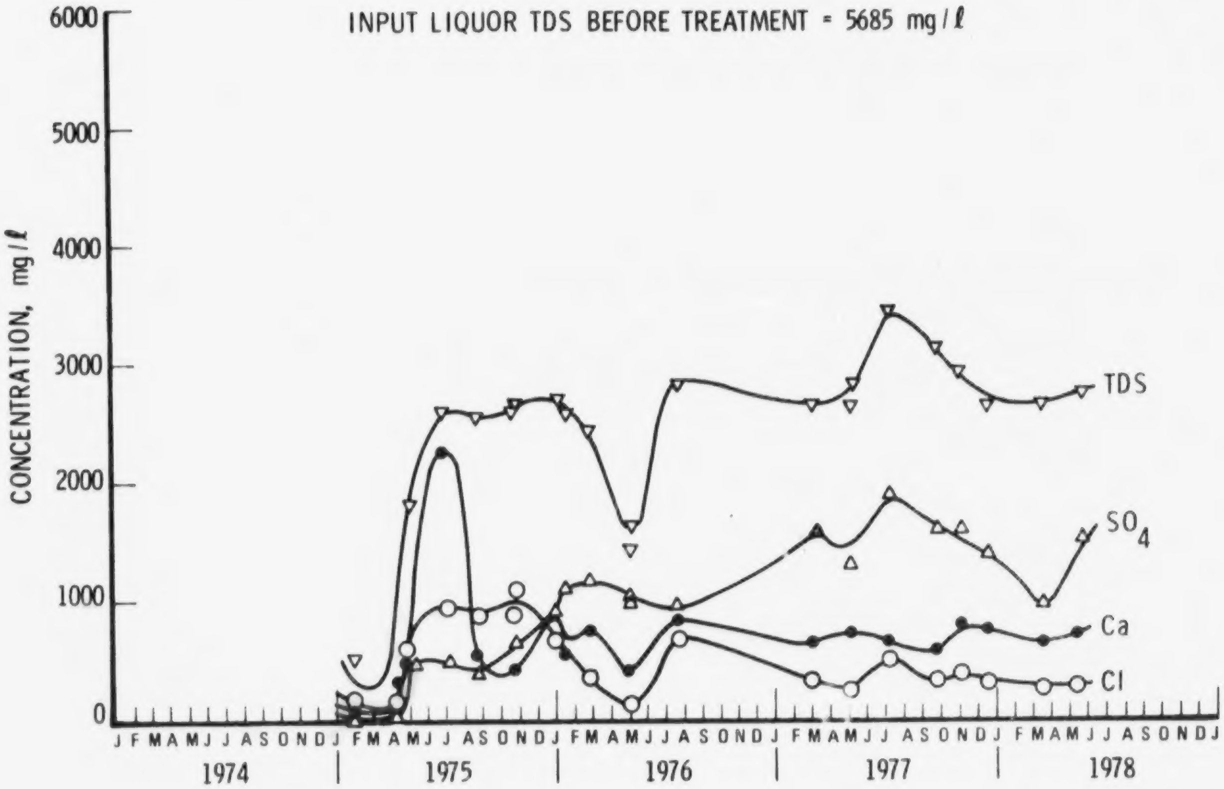


Figure 9. Concentration of TDS and major species in Pond B leachate.

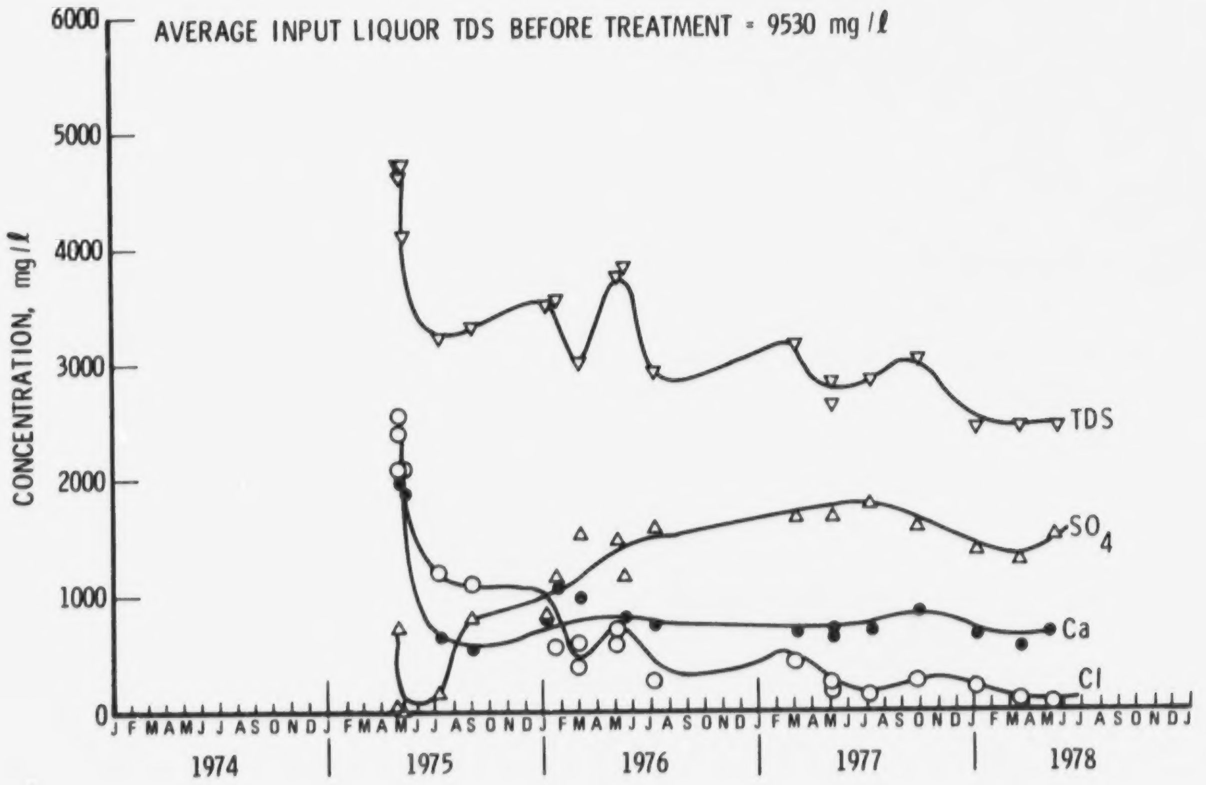


Figure 10. Concentration of TDS and major species in Pond C leachate.

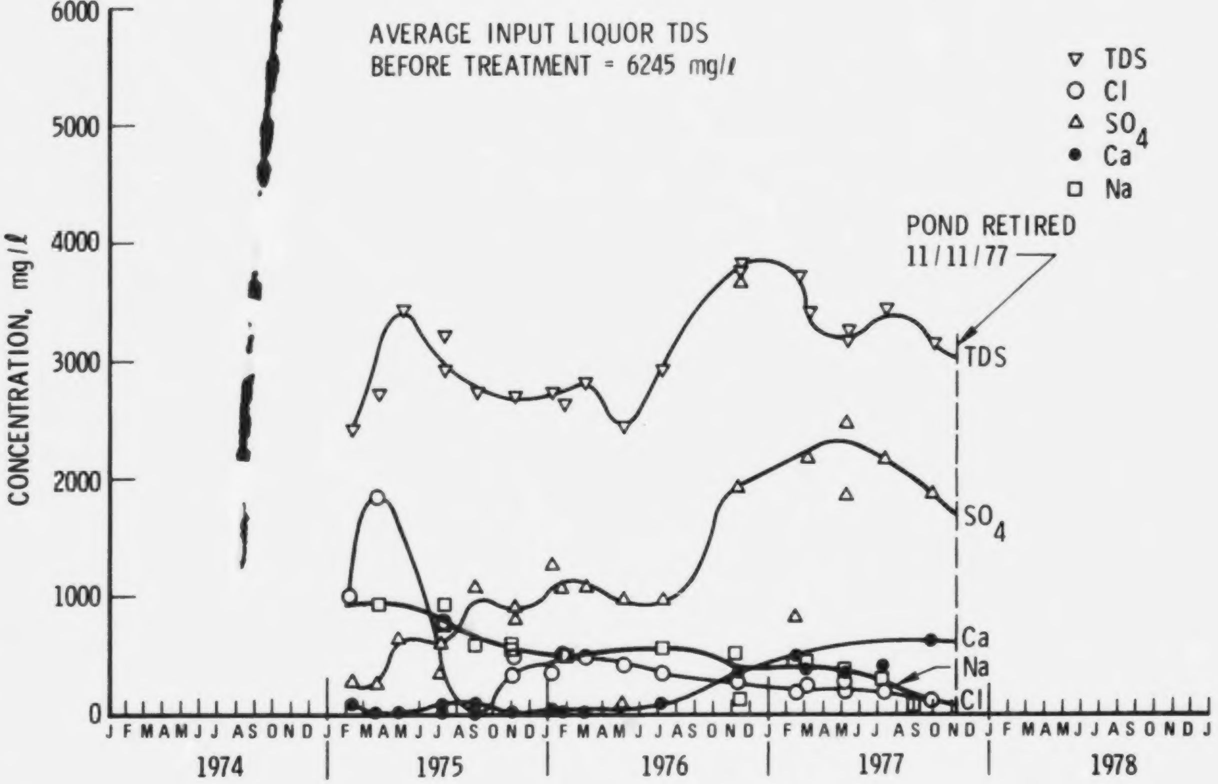


Figure 11. Concentration of TDS and major species in Pond E leachate.

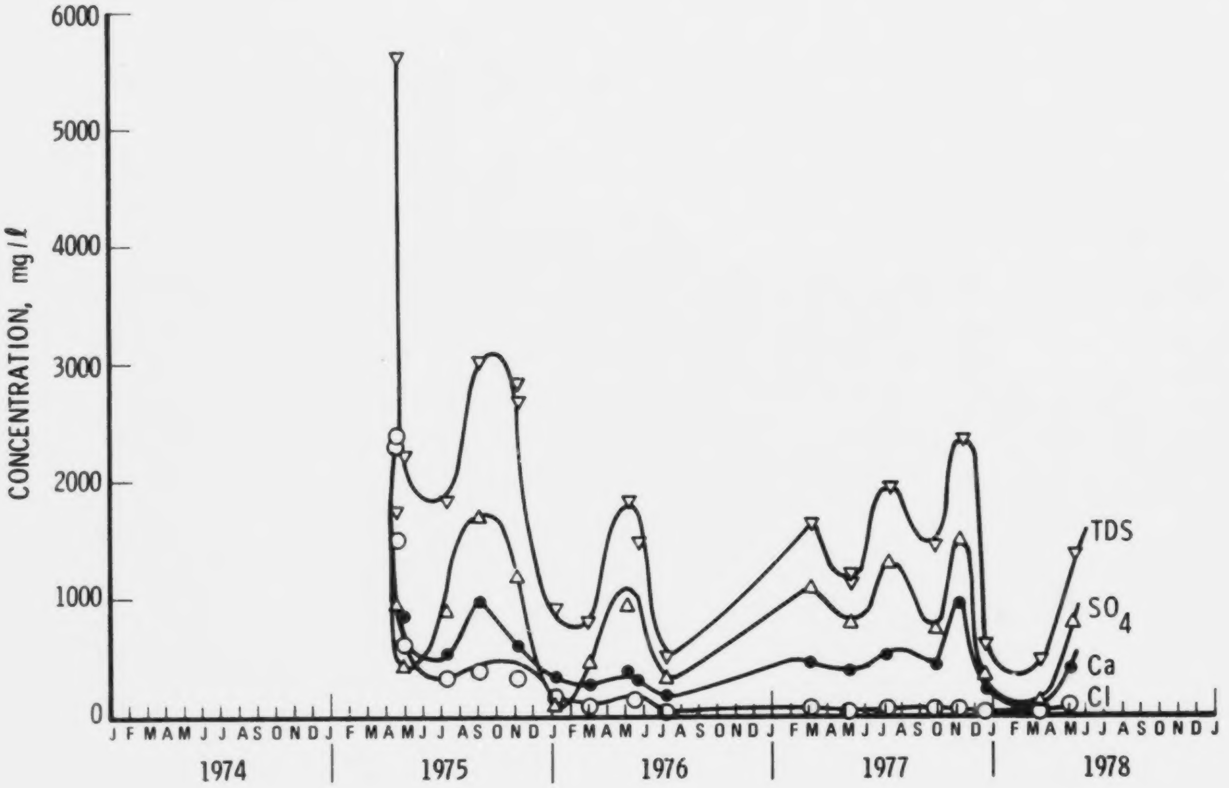


Figure 12. Concentration of TDS and major species in Pond B supernate.

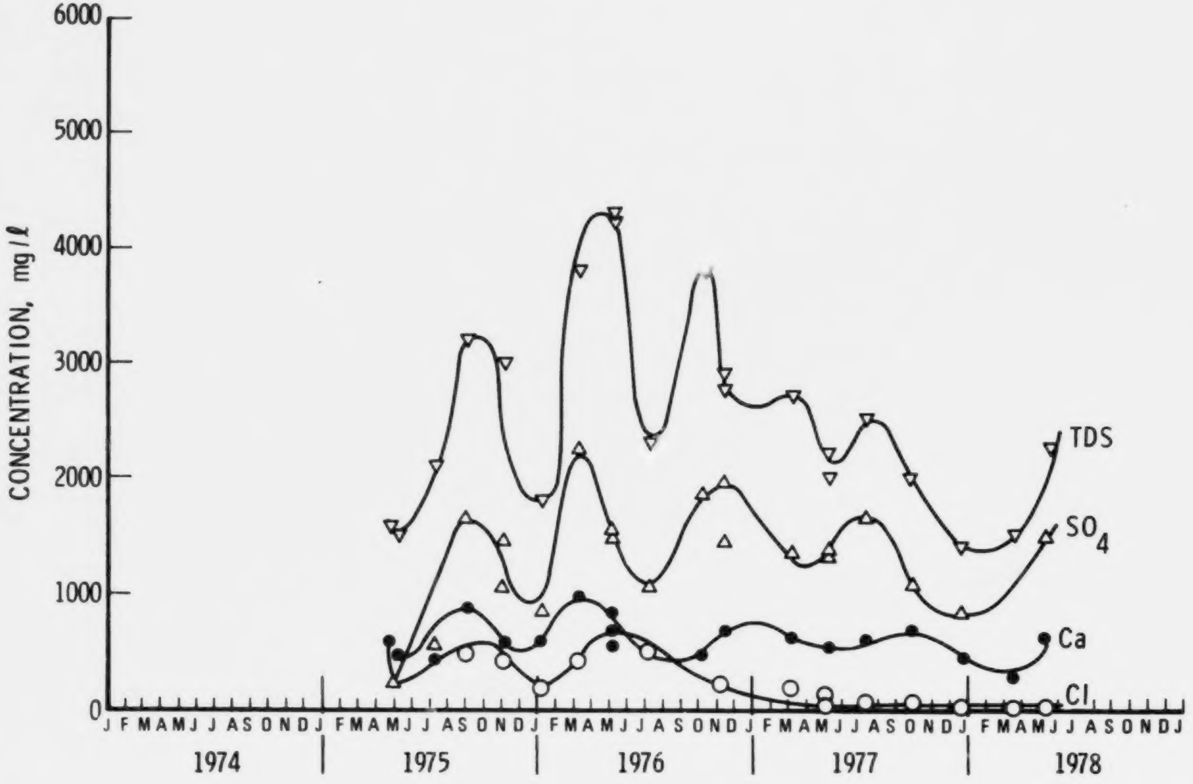


Figure 13. Concentration of TDS and major species in Pond C supernate.

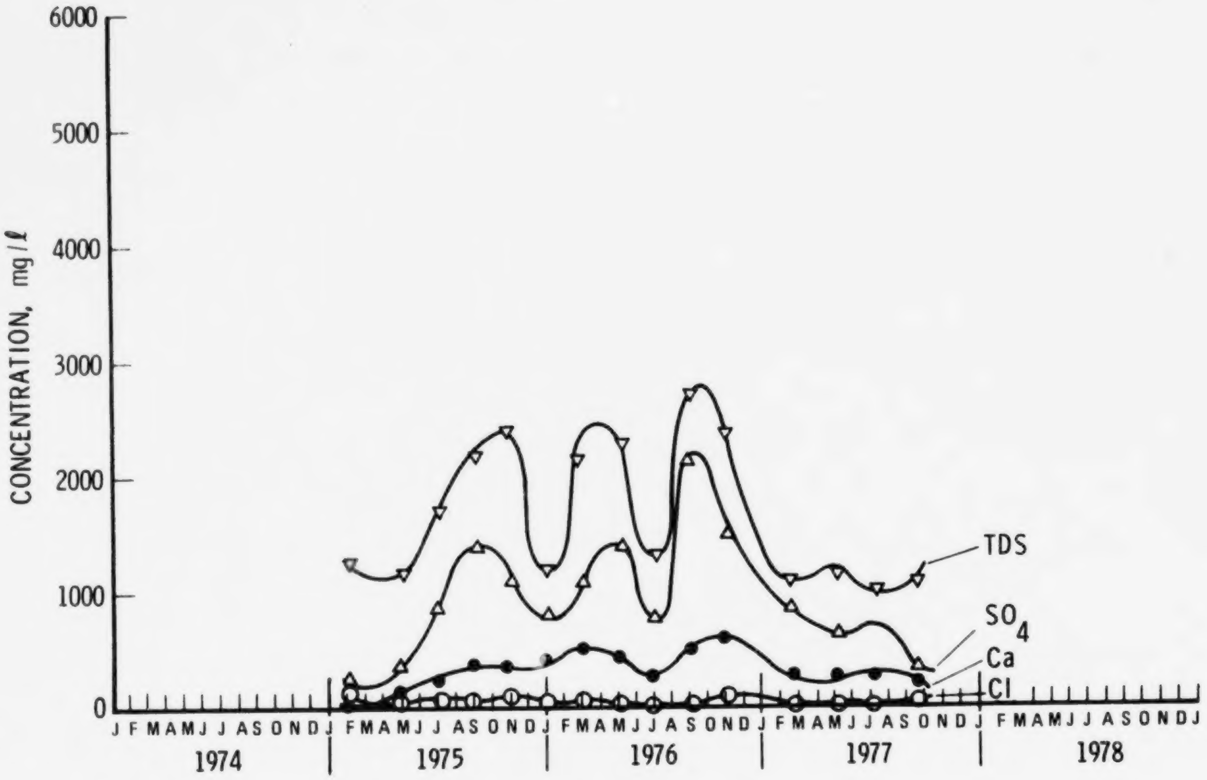


Figure 14. Concentration of TDS and major species in Pond E supernate.

4.2.3 Groundwater

The results of analyses of groundwater associated with these ponds containing treated sludge show no effect from the pond materials. The concentrations of TDS and major constituents in the groundwater have been essentially constant throughout the entire monitoring period. Likewise, the concentrations of six selected minor species have also shown no unusual trends.

4.2.4 Physical Characteristics

Tests were conducted on core samples obtained two years after chemical treatment (March and September 1977) to determine the permeability, moisture content, wet and dry density, and unconfined compressive strength of core samples obtained from Ponds B, C, and E. Typical permeability coefficients ranged from 3.7×10^{-5} cm/sec for Pond B, to 2.9×10^{-5} cm/sec for Pond C, and 5.6×10^{-5} for Pond E. These values were in the range of results obtained previously for these ponds, thereby indicating no apparent time-dependent trends in the permeability coefficient.

Typical moisture content values for the cored materials from these ponds were 56% for Pond B, 37% for Pond C, and 50% for Pond E.

Bulk densities in the as-sampled wet condition for Ponds B, C, and E are approximately 1.37, 1.52, and 1.37 g/cc, respectively. For Ponds B, C, and E, dry bulk densities are approximately 0.63, 0.94, and 0.68 g/cc, respectively.

The tests for ultimate bearing capacity of the chemically treated materials resulted in values of approximately 300 psi.

4.3 SOIL

Two years after project initiation, soil core samples were obtained below the sludge layer in Ponds D, C, and E and in a nearby location in virgin soil, to determine, through chemical analysis, which chemical constituents were retained in the soil. Samples were taken using Shelby tubes in all four locations at depths equivalent to 1, 3, and 9 in. below the sludge layer. Using a coefficient of permeability of 5×10^{-7} cm/sec for the soil, it is reasonable to assume that the soil was saturated through the first foot below each pond. The results show a buildup of sulfate, chloride, and calcium by a factor of 3 over the background concentrations, mercury by a factor of 2, and arsenic by a factor of 1.5. Although iron and lead are known to be retained in soil, the contribution from the leachate could not be determined because of the high concentrations of these elements in the soil itself. The sensitivity of the test equipment was such that no data could be obtained for cadmium or selenium. The conclusion reached from these tests is that there is some retention of some of the sludge constituents in the soil, tending to reduce the concentrations of these constituents in the seepage. The data from these tests, however, were not sufficient to predict the net impact on the quality of the groundwater from the seepage.

4.4 COSTS

Engineering cost estimates were prepared for six disposal options, i.e., ponded untreated waste on an indigenous soil liner; ponded untreated waste on a Hypalon liner; untreated waste in an underdrained pond; forced oxidation (gypsum) waste on indigenous soil; gypsum on Hypalon liner; and ponded chemically treated waste on indigenous soil. In both gypsum cases, a 15% solids slurry is pumped to the disposal site. The estimates were based on mid-1980 costs. The detailed conditions and results are contained in Section IX. A summary of the cost estimates for these five disposal options is shown in Table 4.

TABLE 4. COST COMPARISON OF VARIOUS DISPOSAL METHODS

Disposal Method	$/Ton (dry)	Mills/kWH	$/Ton Coal
Untreated, Indigenous Soil	5.88	0.66	1.77
Untreated, Hypalon 30 Liner	12.54	1.42	3.78
Untreated, Underdrained	9.42	1.06	2.84
Gypsum, Indigenous Liner	10.22	1.18	3.14
Gypsum, Hypalon 30 Liner	15.06	1.74	4.63
Chemically Treated	11.83	1.24	3.60

SECTION V

ORGANIZATION AND MANAGEMENT

This project is managed by the EPA Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina. The functional relationships of the organizations participating in the project are shown in Figure 15.

The Aerospace Corporation is responsible for project planning and coordination, preparation of project test plans, laboratory analyses of ponded test plans, laboratory analyses of ponded waste materials and pond waters, preparation of engineering cost estimates for the disposal processes being evaluated, assessment of all analytical results, and reporting of project activities and analytical results.

The Tennessee Valley Authority (TVA) is responsible for all construction, filling of untreated ponds, supplying sludges to chemical treatment processors at the site, site maintenance, sampling and analyses, sample distribution, climatological and hydraulic data collection, photographic documentation (still and motion picture), and contracting with sludge treatment processors. TVA also provides analytical data, climatological and hydraulic data, and photographic documentation to The Aerospace Corporation for assessment and inclusion in formal reporting to EPA.

The processors who have chemically treated sludges now under evaluation are Chemfix, Inc., and Dravo Corporation, Pittsburgh, and IU Conversion Systems, Inc., Philadelphia, Pennsylvania.

The Bechtel Corporation provides scrubber test data relative to the sludges used in the disposal evaluation.

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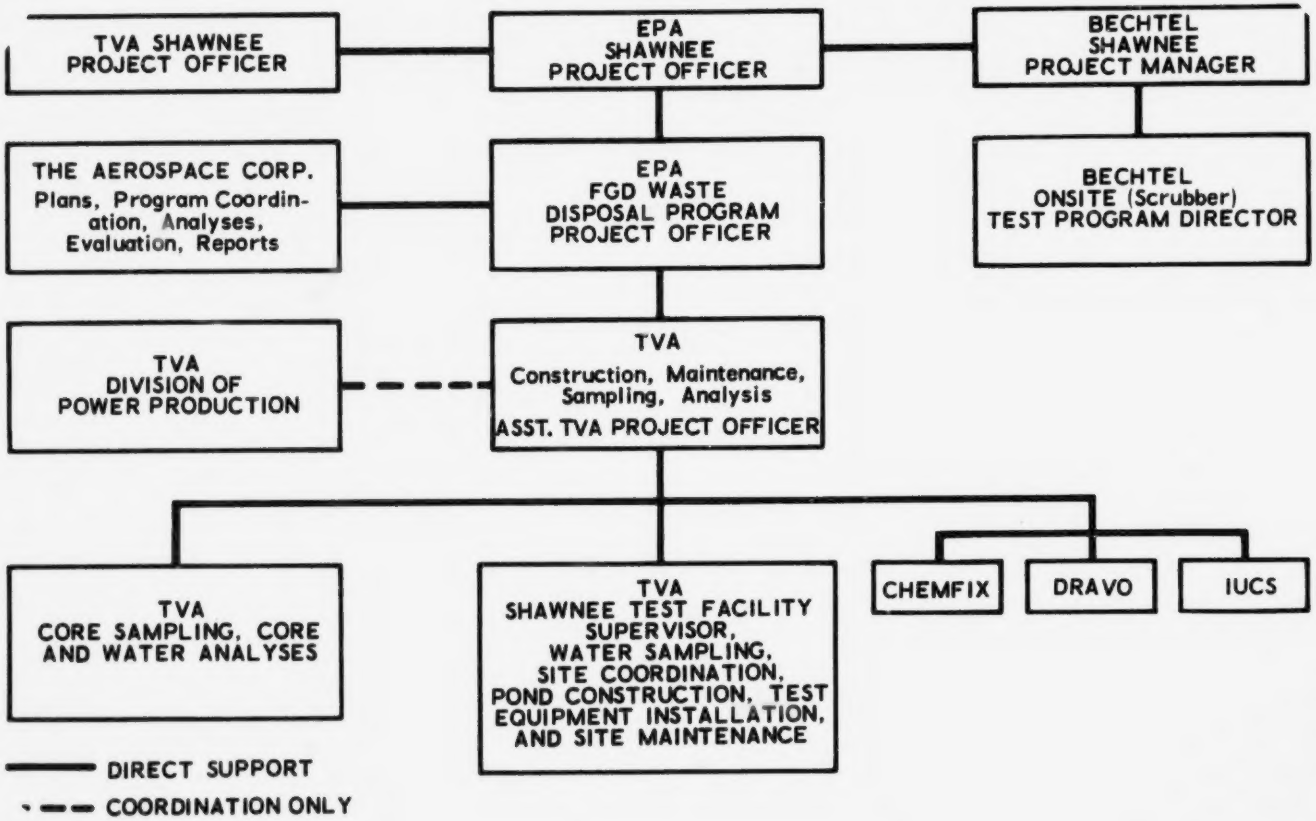

TVA SHAWNEE PROJECT OFFICER
EPA SHAWNEE PROJECT OFFICER
BECHTEL SHAWNEE PROJECT MANAGER
THE AEROSPACE CORP. Plans, Program Coordination, Analyses, Evaluation, Reports
EPA FGD WASTE DISPOSAL PROGRAM PROJECT OFFICER
BECHTEL ONSITE (Scrubber) TEST PROGRAM DIRECTOR
TVA DIVISION OF POWER PRODUCTION
TVA Construction, Maintenance, Sampling, Analysis ASST. TVA PROJECT OFFICER
TVA CORE SAMPLING, CORE AND WATER ANALYSES
TVA SHAWNEE TEST FACILITY SUPERVISOR, WATER SAMPLING, SITE COORDINATION, POND CONSTRUCTION, TEST EQUIPMENT INSTALLATION, AND SITE MAINTENANCE
CHEMFIX
DRAVO
IUCS
DIRECT SUPPORT
COORDINATION ONLY

Figure 1[illegible]. EPA Shawnee FGD waste disposal field demonstration functional organization.

SECTION VI

SITE AND FACILITY DESCRIPTION

6.1 GENERAL

The FGD waste disposal evaluation site is located on TVA property at the TVA Shawnee Steam Plant near Paducah, Kentucky. The Shawnee plant has 10 generating units with a total capacity of 1,750,000 kW of electric power. At its typical level of operation, Shawnee consumes 4,500,000 ton/yr of bituminous coal from western Kentucky and Illinois (Ref. 6). This coal has an average sulfur content of approximately 3.5%.

6.2 TEST FACILITIES

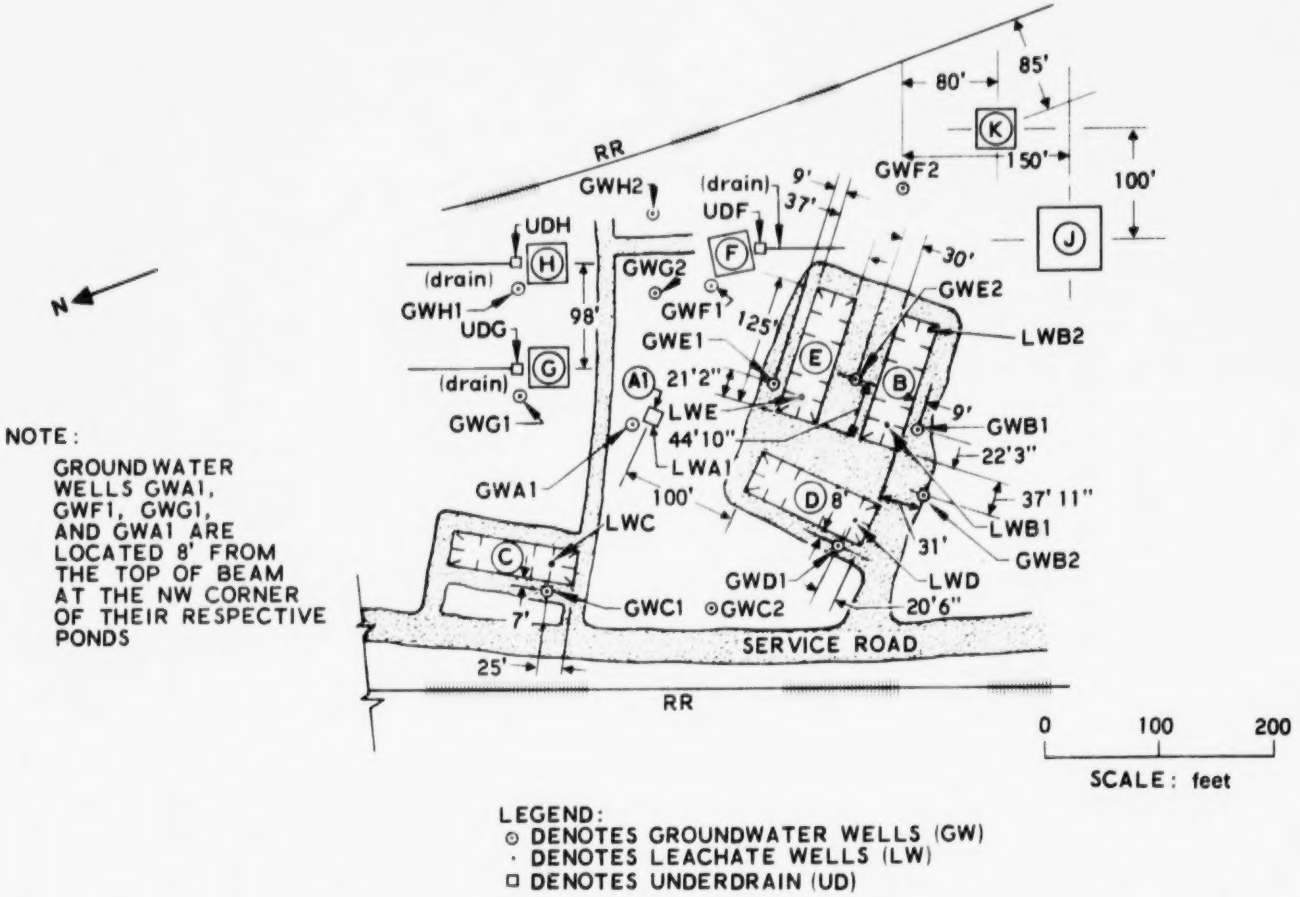
The FGD wastes being evaluated on this project were obtained from two prototype wet lime/limestone scrubbers operating in parallel on Shawnee boiler No. 10, each capable of treating approximately 30,000 ft^3/min (at 300°F) of flue gas (Ref. 7). Gas that is ash-free, or containing ash, may be fed to either scrubber. The two scrubbers, each of which treats an equivalent of 10 MW of boiler capacity, produce an effluent slurry containing sulfite, sulfate, chloride, calcium, and trace elements. The effluent is pumped to a thickener area from which sludge can be removed from a clarifier, centrifuge, or filter for placement in one of the disposal areas. Both treated and untreated sludges are being analyzed in the evaluation program.

6.3 PONDS

The disposal areas are identified as Ponds A1, B, C, D, E, F, G, and H and are shown in relation to the power plant in Figure 16. These ponds have been constructed in accordance with the dimensions shown in Table 5.

All berms are contoured to drain away from the ponds. No other rain drainage is provided, and no compaction of the pond sides or bottom was performed other than that resulting from the operation of earth moving equipment incidental to constructing the ponds. The bottom surfaces are generally in a horizontal plane, and the side walls are protected from erosion through the use of limestone rock.

Leachate wells have been constructed in Ponds A1, B, C, D, and E; and Ponds F, G, and H are constructed with underdrain systems. The configuration of the leachate wells and underdrain systems is described later in this


RR
GWH2
(drain)
UDF
9'
37'
GWF2
80'
85'
K
150'
100'
J
UDH
H
(drain)
GWH1
UDG
G
(drain)
GWG1
98'
GWG2
F
GWF1
125'
30'
GWE2
LWB2
GWE1
E
B
A1
21'2"
LWE
44'10"
LWA1
9'
GWB1
22'3"
37' 11"
LWB1
GWB2
GWA1
100'
D
8'
31'
LWC
C
GWD1
LWD
7'
GWC1
GWC2
20'6"
SERVICE ROAD
25'
RR
0
100
200
SCALE: feet
N

NOTE:
GROUNDWATER WELLS GWA1, GWF1, GWG1, AND GWA1 ARE LOCATED 8' FROM THE TOP OF BEAM AT THE NW CORNER OF THEIR RESPECTIVE PONDS

LEGEND:
⊙ DENOTES GROUNDWATER WELLS (GW)
· DENOTES LEACHATE WELLS (LW)
□ DENOTES UNDERDRAIN (UD)

Figure 16. Disposal site and well nomenclature

TABLE 5. SHAWNEE POND DIMENSIONS

Pond	Length, ft[a]	Width, ft[a]	Side Slope	Sludge Depth, ft
A1	10	10	2:1	3
B, E	140	38	2:1	3
C	133	38	2:1	3
D	147	40	2:1	3
F	40	40	2:1	4
G, H	40	40	2:1	4

[a] Length and width dimensions are to the top of the berm.

section. Access to the leachate well in Pond A1 has been provided by constructing a walkway across the berms adjacent to the well. For each of Ponds B, C, D, and E, a wooden pier has been constructed at one end of the pond to serve as a support for the leachate well and to provide a sampling station for obtaining leachate well water. For Ponds F, G, and H, access has been provided to the underdrain collection tank and pump, for inspection and maintenance purposes, through the use of metal steps placed in the concrete liner of the collection pit.

6.3.1 Leachate Well Construction

Leachate wells have been constructed on the flat bottom of Ponds A1, B, C, D, and E. The purpose of these wells is to provide water samples that can be analyzed to determine the quality of the water that seeps through the sludge (either untreated or treated) and enters the soil. These wells provide samples except during periods of extreme drought or subfreezing weather.

The wells have been built with 4-in.-diam plastic pipes implanted as shown in Figure 17. This configuration is arranged to prevent solid material from blocking the entrance to the pipe. The pipe extends approximately 5 ft above the base of the pond. It is anchored to the pier (except for Pond A1) and is covered with a force-fit plastic cap to prevent entry of foreign matter (including rainwater) into the well. The installation is such that surface water cannot freely flow between the sludge and the pipe or through the upper end. A layer of diatomaceous earth is used to filter suspended solids in the leachate.

6.3.2 Underdrain Construction

Underdrain systems have been constructed on the bottoms of Ponds F, G, and H. The purpose of these systems is to remove water which seeps to the pond bottom, thereby enhancing sludge drainage, which improves structural properties. Samples of water collected from the underdrain system are analyzed for environmental quality.

The underdrain systems are constructed with 4-in.-diam plastic pipe implanted in the pond bottom, as shown in Figure 18. The collection pipes are drilled on their top halves with 1/8-in. holes on 2-in. centers and have been covered with pea gravel. There is a 1-ft layer of sand on top of the pea gravel; this improves the dewatering of the sludge, and filters out particulate matter. The collection pipes are connected to a single gravity-drained pipe which flows to a 100-gal plastic tank. Water is pumped from the collection tank to the surface by a float-operated pump. The water pumped from each pond is metered so that the quantity of water drained can be directly compared to the rainfall measured at the side.

6.3.3 Groundwater Well Construction

A groundwater well has been constructed approximately 100 ft from each pond in the groundwater upstream direction for background water quality

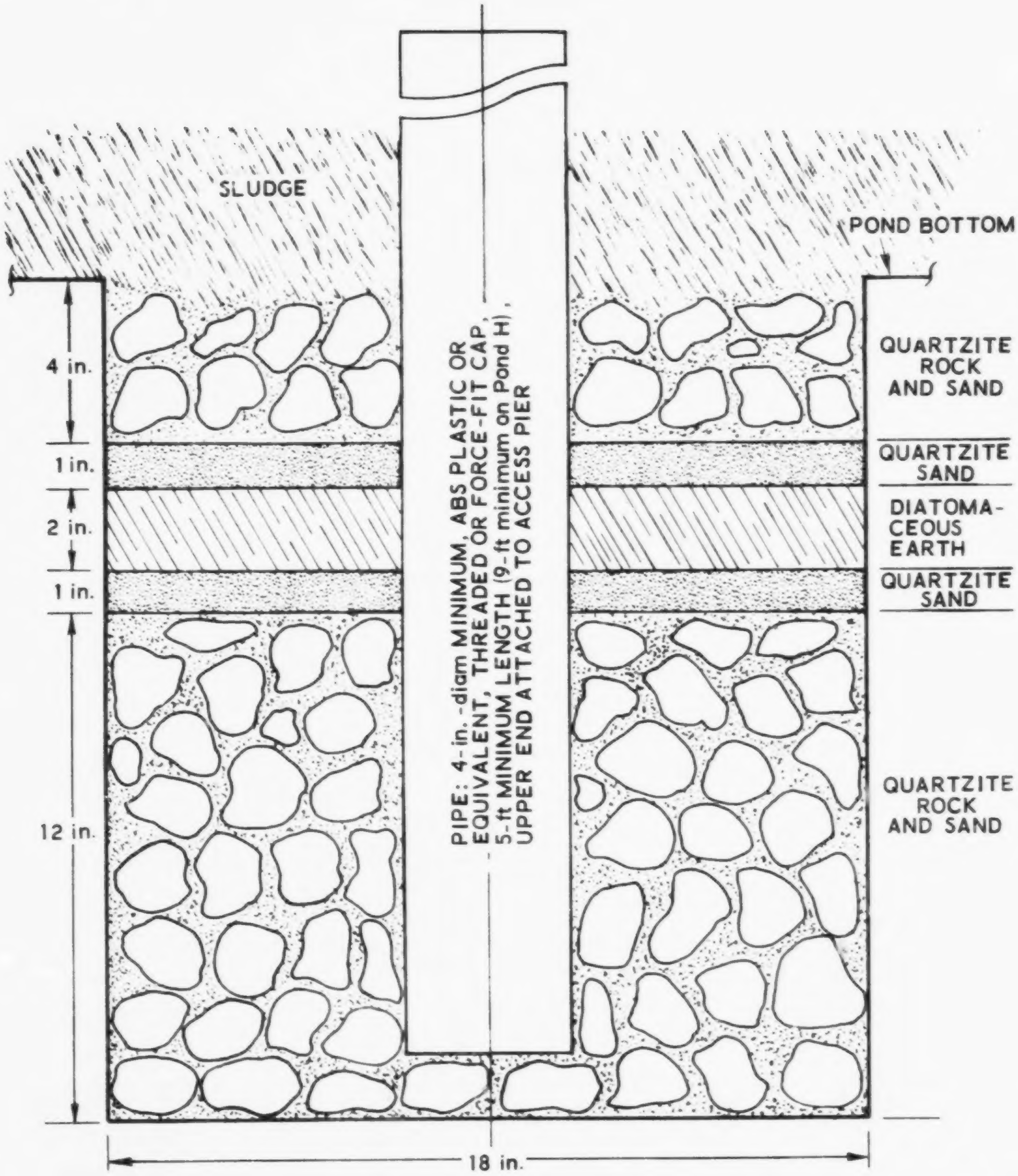

SLUDGE
POND BOTTOM
4 in.
1 in.
2 in.
1 in.
12 in.
18 in.
QUARTZITE ROCK AND SAND
QUARTZITE SAND
DIATOMACEOUS EARTH
QUARTZITE SAND
QUARTZITE ROCK AND SAND
PIPE: 4-in.-diam MINIMUM, ABS PLASTIC OR EQUIVALENT, THREADED OR FORCE-FIT CAP, 5-ft MINIMUM LENGTH (9-ft minimum on Pond H), UPPER END ATTACHED TO ACCESS PIER

Figure 17. Leachate collection well.

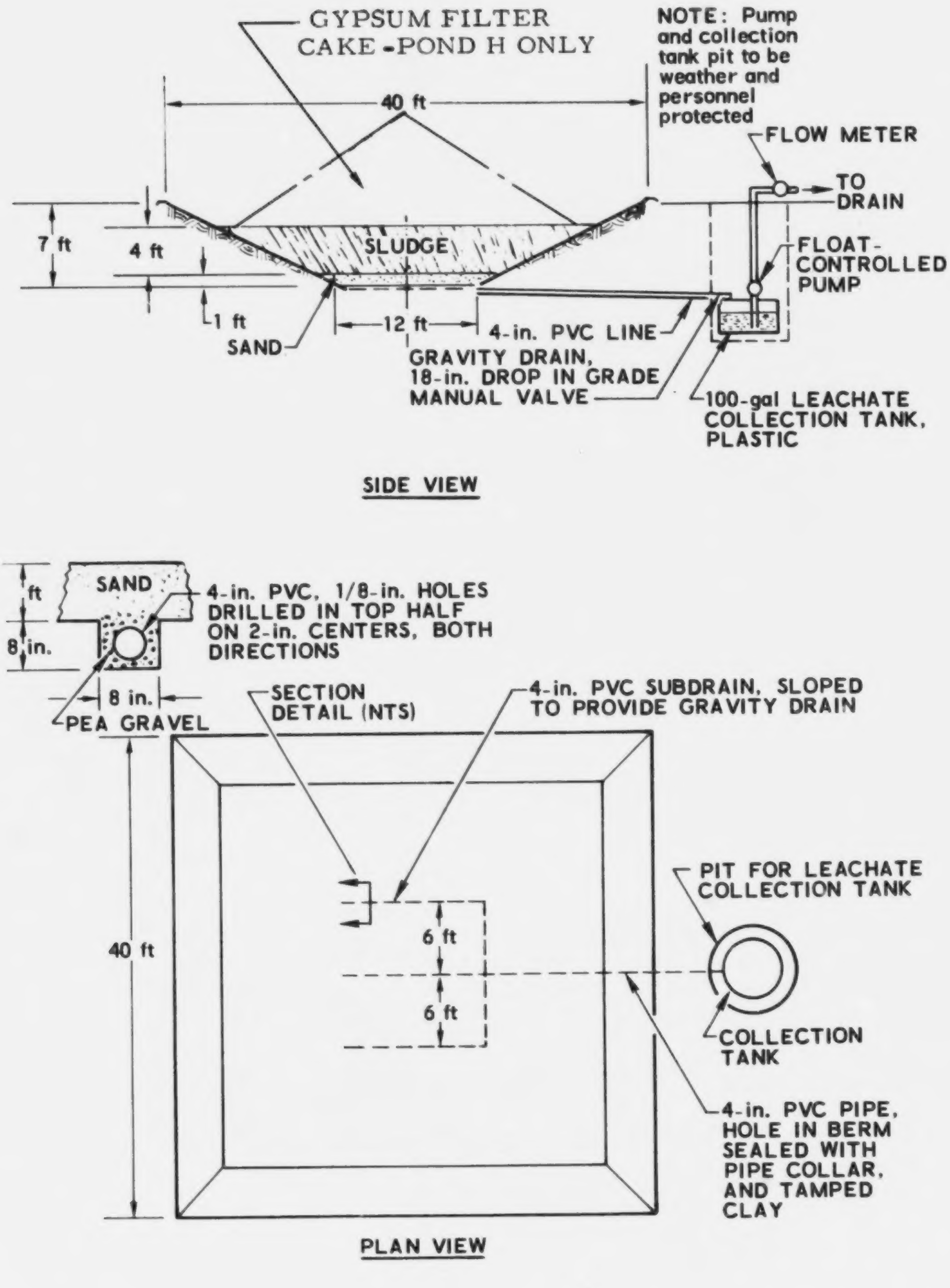

GYPSUM FILTER CAKE -POND H ONLY
NOTE: Pump and collection tank pit to be weather and personnel protected
40 ft
FLOW METER
TO DRAIN
7 ft
4 ft
SLUDGE
FLOAT-CONTROLLED PUMP
1 ft
SAND
12 ft
4-in. PVC LINE
GRAVITY DRAIN, 18-in. DROP IN GRADE
MANUAL VALVE
100-gal LEACHATE COLLECTION TANK, PLASTIC
SIDE VIEW
ft
SAND
8 in.
4-in. PVC, 1/8-in. HOLES DRILLED IN TOP HALF ON 2-in. CENTERS, BOTH DIRECTIONS
8 in.
PEA GRAVEL
SECTION DETAIL (NTS)
4-in. PVC SUBDRAIN, SLOPED TO PROVIDE GRAVITY DRAIN
40 ft
PIT FOR LEACHATE COLLECTION TANK
6 ft
6 ft
COLLECTION TANK
4-in. PVC PIPE, HOLE IN BERM SEALED WITH PIPE COLLAR, AND TAMPED CLAY
PLAN VIEW

Figure 18. Underdrain system installed in Ponds F, G, and H.

measurements. The wells are constructed of either 4- or 6-in.-diam plastic pipe, anchored in concrete, packed with clay to prevent seepage down the well shaft, and installed to extend from 3 to 5 ft below the water table. The pipe is covered with a force-fit plastic cover.

Groundwater wells have been constructed on the berms of Ponds B, C, D, and E to measure the quality of groundwater at those locations. These wells are located downstream from the pond relative to the direction of groundwater flow. Newly constructed Ponds F, G, and H do not have groundwater wells installed on the pond berms. On the basis of experience with the other ponds, a single well installed in the downstream direction should be adequate to monitor these ponds.

6.4 WEATHER DATA STATION

A data-taking station, containing both recording and nonrecording instrumentation, has been installed for the purpose of determining weather conditions at the site that may affect the disposal evaluations. Initially, this station was located in the vicinity of the original site of Pond A; however, since February 1975, it has been located in the vicinity of Pond D, which is somewhat central to the total site evaluation area.

Measurements made at this station include the following:

a. Air and water temperature

b. Precipitation

c. Evaporation

d. Wind movement

e. Relative humidity

SECTION VII

OPERATIONS AND SCHEDULES

The first five disposal ponds (A through E) were constructed in 1974, and disposal evaluation activities began when the first of these, Pond A, was filled between September 24 and October 3, 1974. The filling of four additional ponds (B through E) was completed by mid-April 1975. The construction of Ponds F, G, and H was completed in September 1976, and these ponds were subsequently filled during the following 12 months, i.e., G in October 1976, F in February 1977, and H in September 1977. The source materials and other characteristics for all of the ponds are summarized in Table 6. Detailed descriptions of the filling of Ponds A through E, A1, and G have been published in other reports (Refs. 1 and 2). Ponds F and H were filled during this reporting period (i.e., between October 1976 and May 1978); a description of those operations follows.

7.1 POND FILLING AND CHEMICAL TREATMENT

The two ponds filled during this reporting period represent a continuing investigation of a cross section of FGD waste disposal materials and methods. Materials ponded previously include untreated lime and limestone wastes in indigenous clay ponds; lime and limestone wastes chemically treated and evaluated under conditions representing either a low spot in a landfill or disposal behind a dam; and untreated, dewatered ash-free lime waste mixed with fly ash and placed in an underdrained pond in alternate layers with additional fly ash. Bench tests in the Aerospace laboratories on Shawnee wastes have continued to show that untreated sludges, when underdrained, exhibit much improved load-bearing strengths (when measured by the modified California bearing ratio test described in Appendix B). Inasmuch as the underdraining removes or minimizes the hydraulic head of the ponded leachate, thereby reducing its pollution potential as well as improving its structural properties, there has been a continuing interest in obtaining additional field data on this disposal method. Since the first underdrained pond used lime waste (Pond G), the fill material for Pond F was selected from a limestone test run. Likewise, there has been increasing interest in oxidized sulfite (gypsum) scrubbing processes and, thus, an interest in evaluating the pollution potential of gypsum waste. The fill material for Pond H, therefore, was selected from a gypsum ash-free test run, and both clarifier underflow and filter cake were used. The material was placed in an underdrained pond to permit the evaluation of underdrained gypsum clarifier underflow and field storage of gypsum filter cake using the same disposal pond.

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TABLE 6. SHAWNEE DISPOSAL SITES

Site	Fill Date	Scrubber Type[a]	Sludge		Solids[c] Content (wt %)	Treatment	Remarks
			Absorbent	Source[b]			
A	10/8/74	VST	Lime	F	46	Untreated	Out of service 4/15/76
A1	5/10/76	VST	Lime	F	46	Untreated	Control pond, transferred from Pond A
B	4/15/75	TCA	Limestone	CU	38[d]	Dravo	Underwater disposal
C	4/23/75	VST	Lime	CE	55[d]	IUCS	Pond converted to runoff mode 3/79
D	2/5/75	TCA	Limestone	CU	38	Untreated	Control pond
E	12/7/74	TCA	Limestone	CU	38[d]	Chemfix	Closed 11/77
F	2/3/77	TCA	Limestone	CU	47	Untreated	Underdrained pond, closed 11/77
G	10/5/76	VST	Lime	CE	47	Untreated	Underdrained pond
H[e]	9/2/77	VST	Limestone	CU	33	Untreated	Pond
	9/30/77	VST	Limestone	F	86	Untreated	Surface site, unreacted limestone 13% dry wt

[a] Venturi and spray tower (VST); turbulent contact absorber (TCA).

[b] Filter (F), clarifier underflow (CU), and centrifuge (CE).

[c] Pond H is ash-free. All others: fly ash is approximately 40 wt % of solids content.

[d] Prior to chemical treatment.

[e] Forced-oxidized to gypsum.

7.1.1 Pond F

Pond F was filled during the period of January 28 to February 3, 1977 with ash-free limestone sludge remixed with fly ash. The sludge was obtained from the Universal Oil Products turbulent contact absorber (TCA) scrubber during an ash-free scrubbing run, using limestone as the absorbent. Ash-free sludge was obtained from the TCA clarifier tank (D 202) at a solids content of approximately 37 wt% and pumped directly to a concrete mix truck. The trucks were loaded at a rate of 5 gpm from the clarifier. Fly ash, mixed in a ratio of 2:1 [mechanically collected and electrostatically precipitated (ESP)], was added manually from 55-gal drums by means of a crane and a scaffold in a quantity equivalent to 40% of the total solids in the sludge. Three concrete trucks were used, having capacities of 7-1/2, 8, and 10 yd^3. To fill the pond, a total of 147 yd^3 of clarifier underflow was used and a total of 38.4 yd^3 of fly ash. The entire filling operation was carried out during weather which was unusually cold for the Shawnee site. Although overnight temperatures dropped to lows of -10°F, the sludge did not freeze in the concrete mix trucks. The mixer drums were kept rotating at all times. (The filling operation using concrete mix trucks was carried out in spite of the cold weather and was not part of the disposal evaluation; in an operational situation the sludge would be pumped underground to the disposal site.) The pond underdrain system functioned all during the filling operation even though the sludge became frozen each night. The underdrain pump is protected from the weather since it is located at the bottom of the collection silo, and the discharge hose is insulated and protected with a heat-trace system. During the filling operation samples were obtained of clarifier underflow and sludge mix as delivered to the pond from each truck. Samples were also obtained of pond underdrain water before and after filling, and two additional samples were taken during the filling operation. The sludge and underdrain water were analyzed for chemical characterization, and the sludge was analyzed for solids content (Section VIII). The pond underdrain water will be sampled and analyzed bimonthly, similar to the leachate from the other ponds.

7.1.2 Pond H

Pond H was filled during the period of August 18 through September 30, 1977 with ash-free oxidized sulfite limestone sludge (gypsum). The filling and testing of the pond was accomplished in three stages. The first task was to fill the pond to a depth of 4 ft with gypsum sludge in the form of clarifier underflow. The second task was to test the settling characteristics and load-bearing capacity of this same material. The third task was to construct a 10-ft pile of ash-free gypsum sludge in the form of filter cake in order to assess settling and weathering characteristics, load-bearing capacity, and the environmental quality of the runoff.

Phase I: Filling with Clarifier Underflow

Ash-free oxidized sulfite sludge was obtained from the venturi spray tower clarifier at an average solids content of 33 wt% and pumped directly into a concrete mix truck. The trucks were loaded at a rate of 5 gpm from the clarifier. Two concrete trucks were used, each having an 8-yd^3 capacity. Both trucks were filled overnight and dumped in the morning; one truck was filled during the day and pumped in the afternoon. The mixer drums were kept rotating at all times. The pond underdrain system functioned all during the filling operation. A total of 43 truckloads was delivered to the pond. The slurry settled to an average height of approximately 3 ft, 11 in., with a surface area of 36 × 36 ft representing a total volume of approximately 84 yd^3.

Phase II: Sampling and Testing

During the filling operation, samples of the clarifier underflow sludge were obtained from each truck as it was being dumped into the pond. Daily samples of the underdrain water were also obtained throughout the time of filling. The sludge and underdrain water have been analyzed (see paragraph on Water Analysis Data on page 46) for chemical characterization along with the solids content of the sludge.

After the pond was filled on September 2, 1977, settling data and ultimate bearing capacity tests were made. These tests involved measuring the moisture content and making penetrometer readings on selected parts of the surface. All bearing capacity measurements were made with a Soiltest, Inc., Model CN-988, penetrometer using a No. 1 probe having a cross-sectional area of 0.33 in^2. The data taken during this phase are summarized in Table 7. For comparison purposes, bearing capacity data taken at other ponds during the same period are shown in Table 3. On September 21, 1977 the surface of the settled clarifier underflow was also subjected to a wheeled vehicle test, i.e., a farm tractor weighing 4000 lb. Two thirds of the surface was sufficiently dewatered to support the tractor, but the tractor became mired in the section that hadn't had sufficient time to drain (this was the area over a sloped sidewall, which was not equipped with underdrainage).

Phase III: Placement of Gypsum Filter Cake

Ash-free gypsum filter cake, obtained from the same scrubber run, was collected and transported by dump truck to the pond. This effort began September 19 and progressed through September 28, 1977. The filter cake was generated at a rate of 1 yd^3/hr. The material was loaded into a dump truck by a conveyor belt. During the daytime, a truck with maximum capacity of 8 yd^3 was used. A larger truck, of 35-yd^3 capacity, was used for the overnight run. The material was transported and dumped, as the trucks became full, on a holding pad in the pond area. When sufficient material was accumulated, it was loaded onto the pond by a crane with a clam shell bucket. The pond loading with the crane was done Wednesday afternoon, Friday afternoon, Sunday morning, and Wednesday morning, September 21 through September 28, 1977. The pond and the staging pile were kept covered at all times, and the truck loading was suspended during a rainfall. The filter cake was dropped into the center of the pond and built up into a natural pile until the peak reached a height of approximately 10 ft above the settled clarifier underflow. Approximately 122 yd^3 of material was used. The final effort involved grading the perimeter

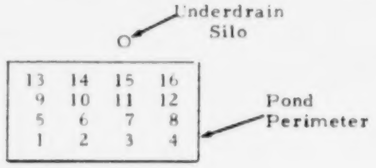
TABLE 7. SETTLING AND PHYSICAL CHARACTERISTICS OF POND H CLARIFIER UNDERFLOW (GYPSUM)

Date	Time	Settling Data		Physical Characteristics											
		Surface Level ft, in.	Water Meter gal.	Solids Content[a]						Bearing Capacity[b]					
				Station	%	Station	%	Station	%	Station	psi	Station	psi	Station	psi
9-6-77	1300	3' 8''	44,720	1	75.2	2	77.6	5	74.8	1	240	2	156	5	165
9-7-77	0930	3' 8''	44,720[c]	3	75.6	7	76.2	8	79.1	3	135	7	180	8	240
9-12-77	0900	3' 7.5''	44,724[c]	11	75.10	12	82.6	15	73.3	11	180	12	135	15	30
9-13-77	0830	3' 7.5''	44,726	Wide deep cracks.											
9-14-77	0715	3' 7.5''	44,973	Raining and wet. No tests.											
9-28-77	1100	--	--							3	330				

[a] Analyses made on samples removed from the surface of the settled clarifier underflow at the stations indicated opposite:

[b] All bearing strength tests made with Soiltest, Inc., Model CN-988 penetrometer using No. 1 needle. Penetrometer probe was allowed to penetrate the surface material to a depth of 1 in. Rain totalling 0.7 in. occurred from 8/29 - 8/30/77, and 0.76 in. occurred on 9/27/77.

[c] Underdrain samples taken for water analysis.



Sample Station Location

of the base of the filter cake so that the runoff from the pile would be channeled into the northeast corner and collected in a 5-gal plastic container. The container has a 4-in. pipe mounted on the side to carry off the excess runoff. A sketch of Pond H is given in Figure 18.

Water Analysis Data

During the three filling phases of Pond H, samples were taken of input liquor and underdrain water. The results of the analyses of these samples are discussed in Section VIII.

7.2 SCHEDULES

A series of schedules are regularly maintained for the project, including an overall schedule and individual schedules for each pond. A complete set of these schedules is contained in Reference 8.

7.3 SAMPLING AND ANALYSIS

An essential part of the evaluation project is the sampling and analysis of input waste materials, pond waters, groundwaters, and soil in the pond bottoms. The supernate, leachate or underdrain, and groundwaters are sampled and analyzed bimonthly for calcium, sulfate, sulfite, chloride, and TDS as well as pH and selected trace elements (see Appendix A). The groundwater is sampled from two locations for each pond, i.e., from a well near the berm on the groundwater "downstream" side of the pond and from a point "upstream" of the pond at a distance approximately 100 ft away. Once each year the leachate or underdrain is analyzed for a full chemical characterization in accordance with Table 8.

Beginning in 1975, core samples have been taken semiannually of the soil in the pond bottoms and of the sludge and soil interface for the three ponds containing chemically treated sludges. The soil samples are analyzed for moisture content, grain size, Atterberg limits, dry density, coefficient of permeability, and concentration of major constituents. The chemically treated sludge core samples are analyzed for physical properties, such as permeability and unconfined compressive strength, and chemical characteristics. An Instron unit, including a calibrated load cell, was used for determining unconfined compressive strength. The results of the sludge and soil analyses are discussed in Sections 8.3 and 8.4. The locations at which core samples have been taken in each pond are shown in Figures 19 through 23 for Ponds B, C, D, E, and F, respectively. Core samples were not taken from Pond A during its operation, primarily because of the proximity of the groundwater to the pond bottom at that location. Coring has not been conducted on Pond A1 because of the restricted size (10 × 10 ft) of that pond, and Ponds G and H have not been cored because of possible damage to the underdrain piping system. It is planned that the latter two ponds be cored just prior to being retired.

TABLE 8. CHEMICAL CHARACTERIZATION PARAMETER LIST[a]

- Aluminum
- Antimony
- Arsenic
- Barium[b]
- Boron
- Cadmium
- Calcium
- Total Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Molybdenum
- Nickel
- Potassium
- Selenium
- Silicon
- Silver
- Sodium
- Tin
- Vanadium
- Zinc
- Total Carbonate
- Chloride
- Fluoride
- Sulfate
- Phosphate
- Total Nitrogen
- Chemical Oxygen Demand
- TDS
- Total Alkalinity
- Conductance, millimhos/cm
- pH

---

[a] Concentration: mg/ℓ unless otherwise indicated.

[b] Item added per revision of 3-1-77.

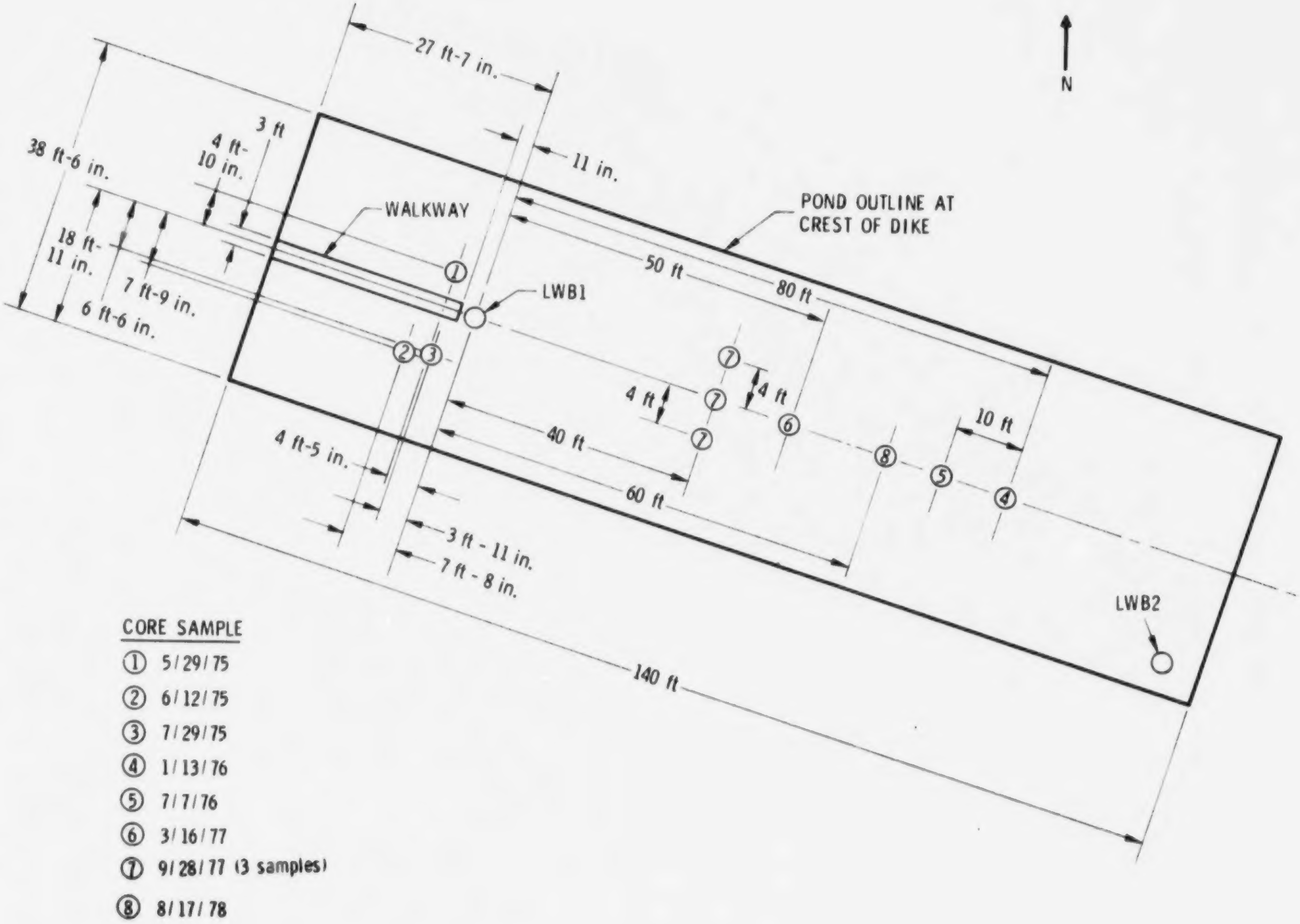

N
27 ft-7 in.
3 ft
4 ft-
10 in.
38 ft-6 in.
11 in.
WALKWAY
POND OUTLINE AT
CREST OF DIKE
18 ft-
11 in.
7 ft-9 in.
6 ft-6 in.
50 ft
80 ft
LWB1
①
②
③
⑦
⑦
⑦
⑥
⑧
⑤
④
4 ft
4 ft
10 ft
40 ft
4 ft-5 in.
60 ft
3 ft - 11 in.
7 ft - 8 in.
LWB2
140 ft
CORE SAMPLE
① 5/29/75
② 6/12/75
③ 7/29/75
④ 1/13/76
⑤ 7/7/76
⑥ 3/16/77
⑦ 9/28/77 (3 samples)
⑧ 8/17/78

Figure 19. Pond B core sample locations and dates.

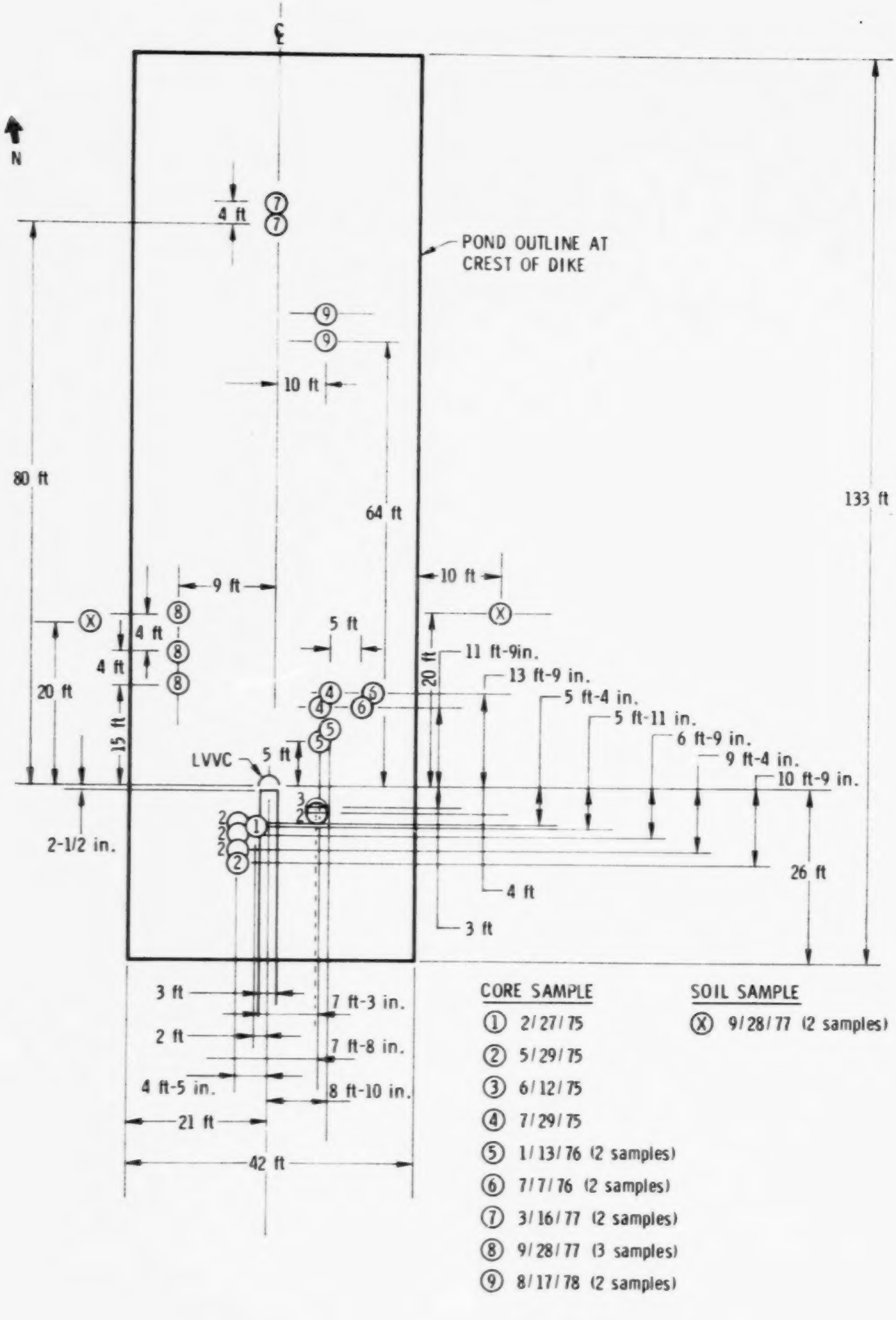

℄
N
4 ft
⑦
⑦
POND OUTLINE AT CREST OF DIKE
⑨
⑨
10 ft
80 ft
64 ft
133 ft
9 ft
10 ft
Ⓧ
⑧
4 ft
⑧
4 ft
⑧
20 ft
15 ft
5 ft
20 ft
11 ft-9in.
13 ft-9 in.
5 ft-4 in.
5 ft-11 in.
6 ft-9 in.
9 ft-4 in.
10 ft-9 in.
④
④
⑤
⑥
⑤
⑤
LVVC
5 ft
3
2
2
2
2
①
②
2-1/2 in.
4 ft
3 ft
26 ft
3 ft
7 ft-3 in.
2 ft
7 ft-8 in.
4 ft-5 in.
8 ft-10 in.
21 ft
42 ft
CORE SAMPLE
① 2/27/75
② 5/29/75
③ 6/12/75
④ 7/29/75
⑤ 1/13/76 (2 samples)
⑥ 7/7/76 (2 samples)
⑦ 3/16/77 (2 samples)
⑧ 9/28/77 (3 samples)
⑨ 8/17/78 (2 samples)
SOIL SAMPLE
Ⓧ 9/28/77 (2 samples)

Figure 20. Pond C core and soil sample locations and dates.

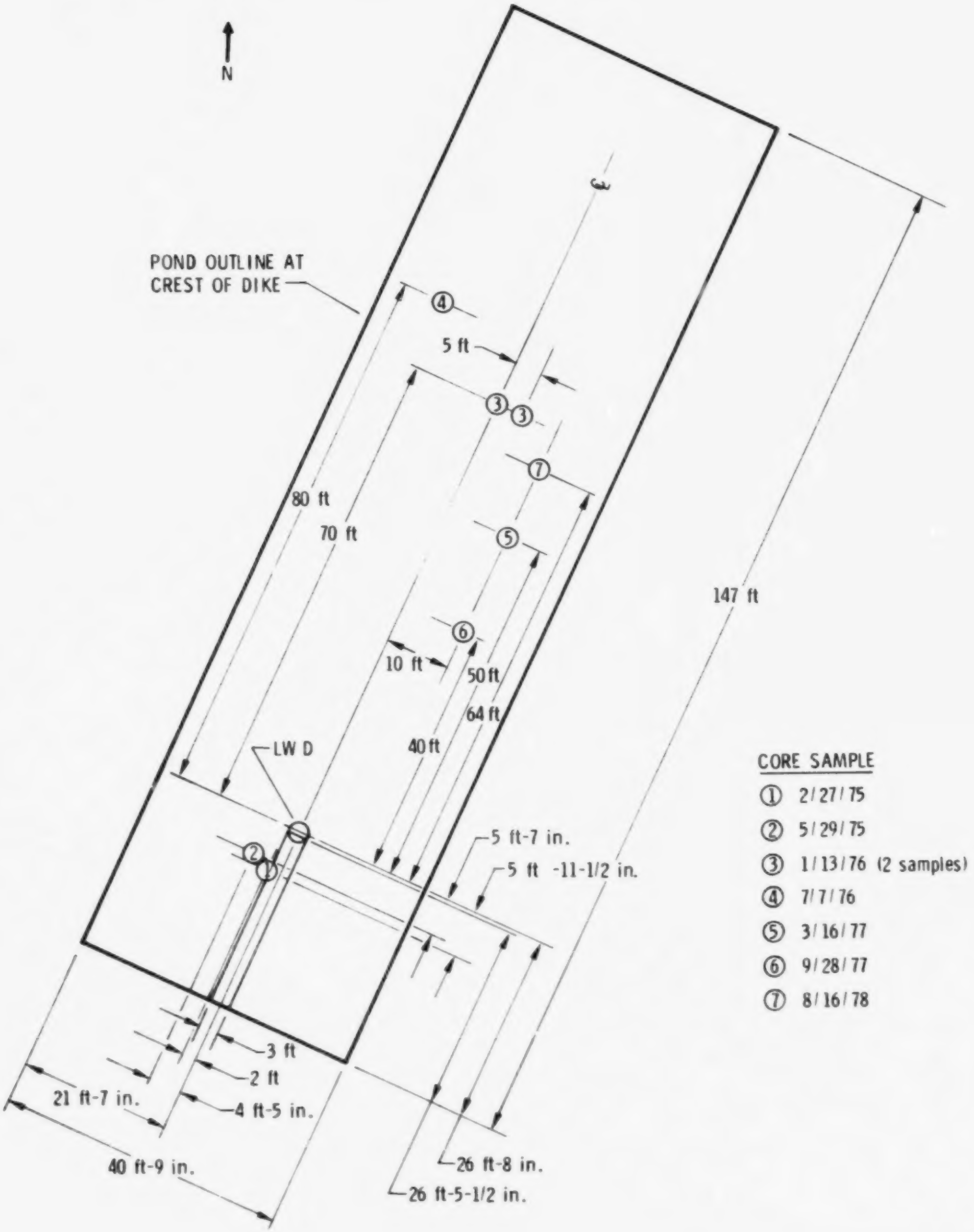

N
POND OUTLINE AT CREST OF DIKE
℄
④
5 ft
③ ③
⑦
80 ft
70 ft
⑤
147 ft
⑥
10 ft
50 ft
64 ft
40 ft
LW D
CORE SAMPLE
① 2/27/75
② 5/29/75
③ 1/13/76 (2 samples)
④ 7/7/76
⑤ 3/16/77
⑥ 9/28/77
⑦ 8/16/78
②
①
5 ft-7 in.
5 ft -11-1/2 in.
3 ft
2 ft
21 ft-7 in.
4 ft-5 in.
40 ft-9 in.
26 ft-8 in.
26 ft-5-1/2 in.

Figure 21. Pond D core sample locations and dates.

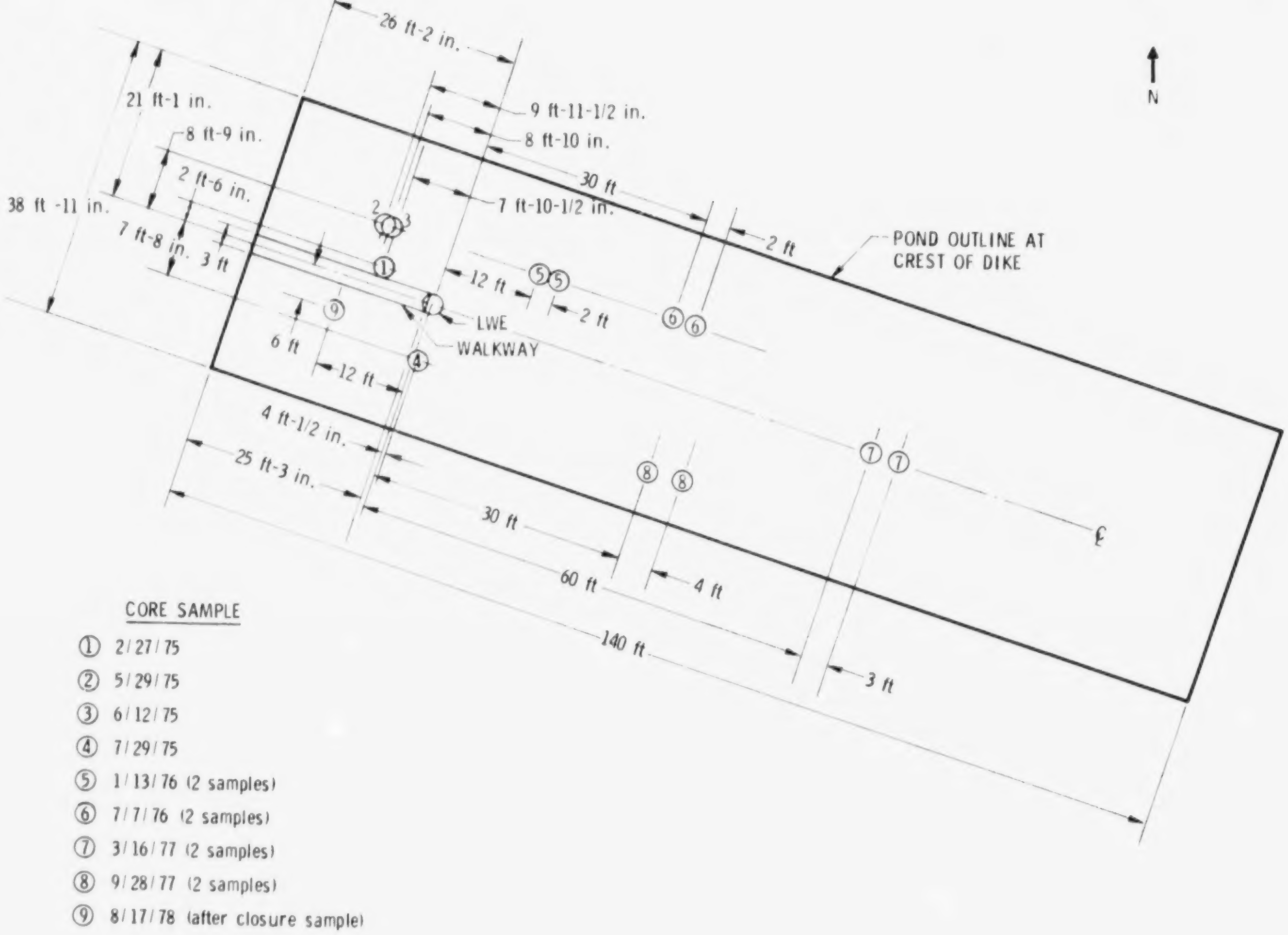

26 ft-2 in.
9 ft-11-1/2 in.
8 ft-10 in.
30 ft
7 ft-10-1/2 in.
2 ft
POND OUTLINE AT CREST OF DIKE
N
21 ft-1 in.
8 ft-9 in.
2 ft-6 in.
38 ft -11 in.
7 ft-8 in.
3 ft
2
3
①
12 ft
⑤⑤
2 ft
⑥⑥
⑨
LWE
WALKWAY
6 ft
④
12 ft
4 ft-1/2 in.
25 ft-3 in.
⑦⑦
⑧⑧
30 ft
60 ft
4 ft
140 ft
3 ft
℄
CORE SAMPLE
① 2/27/75
② 5/29/75
③ 6/12/75
④ 7/29/75
⑤ 1/13/76 (2 samples)
⑥ 7/7/76 (2 samples)
⑦ 3/16/77 (2 samples)
⑧ 9/28/77 (2 samples)
⑨ 8/17/78 (after closure sample)

Figure 22. Pond E core sample locations and dates.

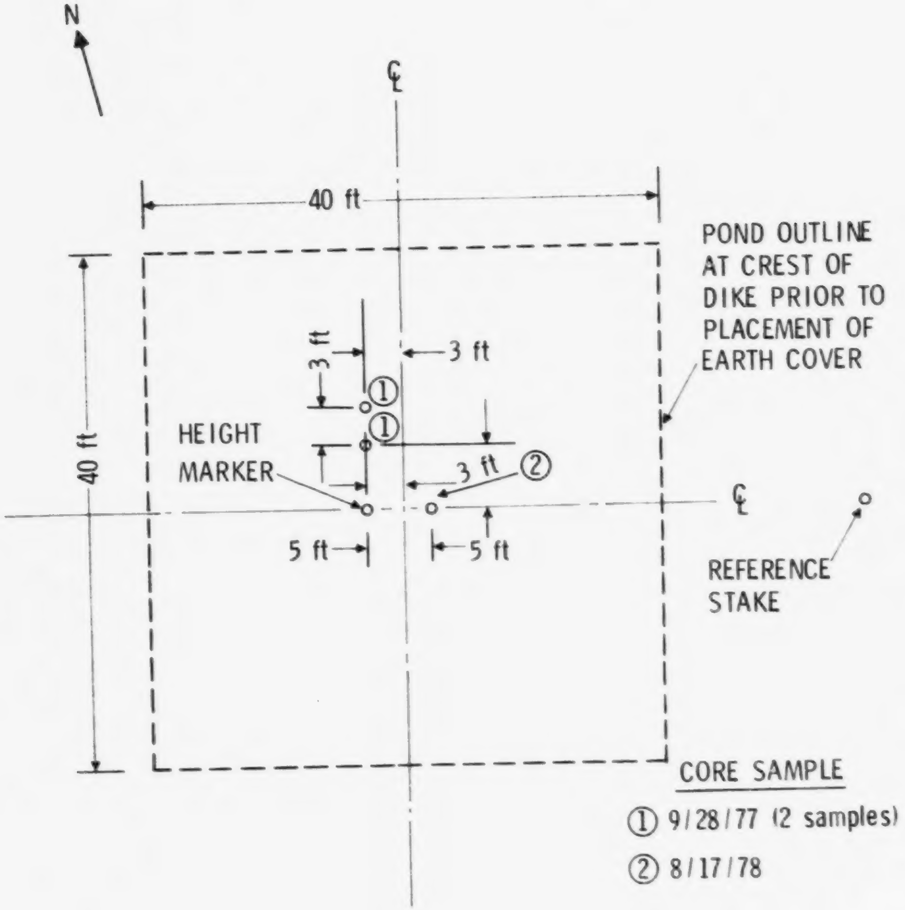

N
℄
40 ft
40 ft
3 ft
3 ft
3 ft
5 ft
5 ft
①
①
②
HEIGHT MARKER
POND OUTLINE AT CREST OF DIKE PRIOR TO PLACEMENT OF EARTH COVER
℄
REFERENCE STAKE
CORE SAMPLE
① 9/28/77 (2 samples)
② 8/17/78

Figure 23. Pond F core sample locations and dates.

7.4 POND CLOSURE (Retirement)

As another step in the evaluation project, two operational ponds were selected for closure and further evaluation in that mode. The two ponds selected were Pond E (chemically treated, Chemfix process) and Pond F (untreated, with underdrain). The purposes of the closure activity are to (1) monitor the quantity and evaluate the characteristics of any seepage from the ponds under conditions simulating the completion of the sludge disposal process, (2) evaluate the structural stability of the soil cover, and (3) observe any effect of sludge uptake in the cover vegetation. Closure was implemented by covering the ponds with soil indigenous to the site, compacting the cover layer, sloping, and planting it with vegetation so that the soil cover will shed rainfall without eroding. The pond leachate well or underdrain system, as appropriate, will continue to be used for sampling and analysis of leachate and underdrain water.

7.4.1 Considerations for Closure of a Landfill

A number of factors were considered in developing the procedures for closure of the two ponds (Refs. 9 and 10). Basically, these factors were in two categories (1) environmental effects and (2) pond use factors, related, in this case, to the use of the disposal-landfill site for power plant operations, e.g., equipment storage and maintenance, parking, activities involving light structures, and park land usage.

Environmental Effects

For a sanitary landfill, the environmental effects related to closure include provisions for controlling conditions affecting public health, e.g., breeding of rodents, flies, and mosquitoes, control of gas migration, and prevention of groundwater contamination by leachate seepage. Since the material to date in the disposal ponds at Shawnee is inorganic, the only pertinent environmental factors are the control of seepage (which will be monitored constantly and is expected to be minimal in quantity as a result of the sloping and depth of the soil cover layer to be installed), and the control of surface waters by use of the diversion ditches surrounding the ponds.

Use Characteristics

Characteristics of these waste materials affecting the end use of a landfill include settling, load-bearing strength, effects of the leachate chemistry on groundwater quality, and possible effects of sludge on plant growth. As mentioned, leachate control is achieved with the earth cover and surface water diversion ditches, and load-bearing capacity is measured prior to and following the application of the soil cover. For purposes of this evaluation, the soil cover depth is varied from 2 to 3 ft. In future activities, the minimum cover may be reduced 0.5 to 1.0 ft in order to evaluate possible seepage under minimum earth cover conditions and to evaluate effects on vegetation.

7.4.2 Procedures Used for Closure of Shawnee Ponds

Specific procedures were followed in the closure of Ponds E and F.

Site Preparation

On both ponds, all surface water was pumped off and all sludge coring holes were evacuated, filled, tamped, and sealed with clay. All limestone rock was removed from the berms, both top and slopes, and disposed of away from the evaluation site. In addition, the following steps were taken for each pond.

Pond E. The leachate well casing was extended upward by 51 in., using a PVC collar and plastic cement sealer so that it was watertight at the joint, and the leachate well was evacuated. The wooden pier was removed, and temporary bracing was provided for the leachate well so that it would not be disturbed during the earth filling operations. All stakes were removed. The holes remaining from the pier supports and stakes were filled with clay and tamped. The rock-free pond berms were cut down to an elevation of 2 ft above the grade of the sludge at the leachate well location (Figures 24 and 25). Dirt removed from the berms was placed in the pond as a part of the final cover layer.

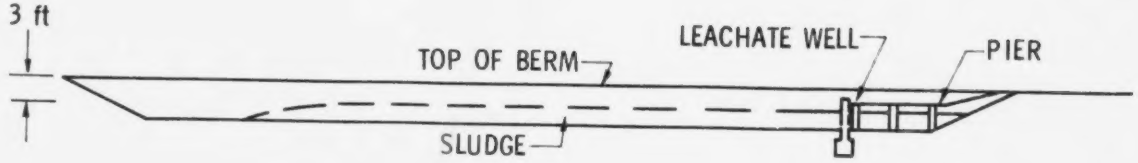
Pond F. The rock-free pond berms were graded to an elevation of one foot above the grade of the sludge at the height marker stake (Figures 26 and 27). Dirt removed from the berms was also placed in the pond as part of the final cover layer.

Placement of Earth Cover

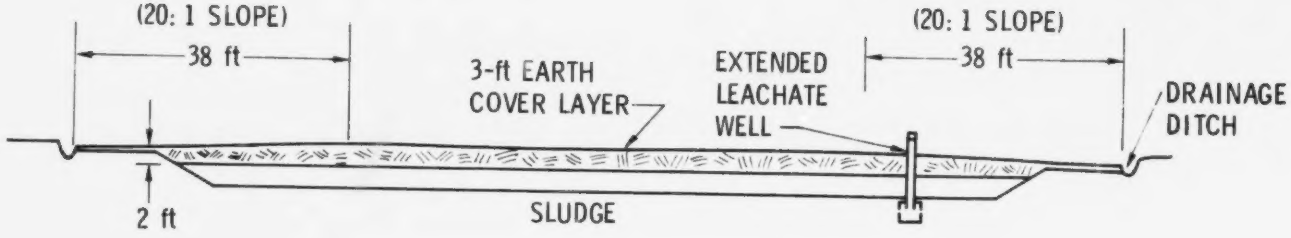
Soil indigenous to the Shawnee site, including the soil removed from the ponds during their original construction, was placed in the ponds to form a final cover layer. The soil was sloped and compacted so that the finished grade was 3 ft deep at the longitudinal centerline of Pond E and at the center of Pond F, and 2 ft deep at the sludge-berm interfaces. Compaction was achieved using an earth-mover weighing 65,000 lb and equipped with rubber tires. Compaction of at least five passes with the earth-mover was made twice during earth filling, i.e., after half the cover height was reached and after the final layer had been placed. The soil adjacent to the leachate well in Pond E and the height marker in Pond F was tamped manually and by a gasoline-driven tamper to achieve a tight seal. Drainage ditches were cleared and graded on the periphery of both ponds to prevent the occurrence of standing water adjacent to the ponds.

Planting and Fertilizing of Earth Cover

Upon completion of the grading and compacting of the earth cover layer, the soil was planted with Kentucky No. 31 fescue at the rate of 6 to 8 lb/1000 ft^2 and fertilized with a 6-24-24 fertilizer at the rate of 20 lb/1000 ft^2. The seed and fertilizer layer was covered with a protective

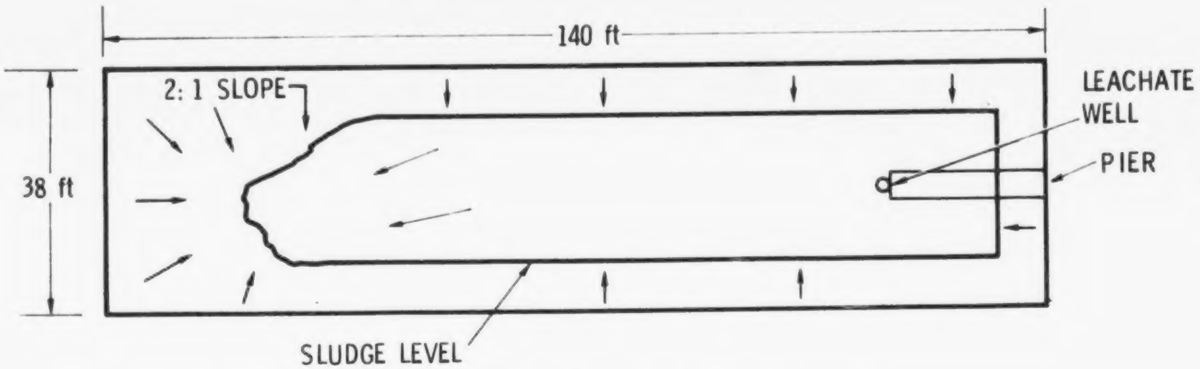

3 ft
TOP OF BERM
LEACHATE WELL
PIER
SLUDGE

(a) BEFORE CLOSURE

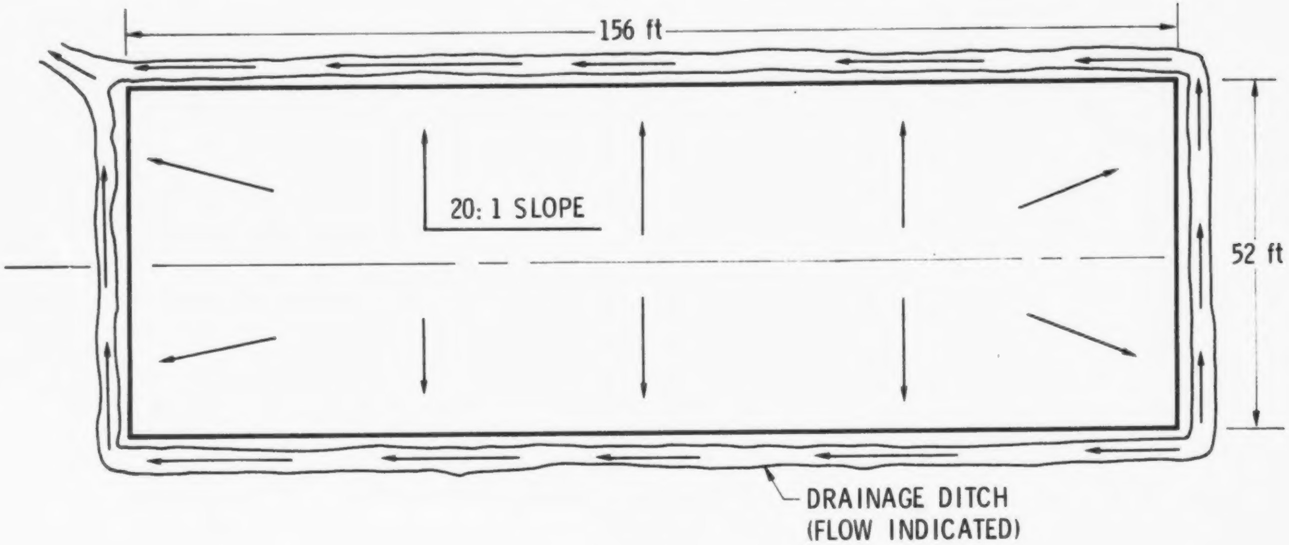

(20: 1 SLOPE)
38 ft
3-ft EARTH
COVER LAYER
EXTENDED
LEACHATE
WELL
(20: 1 SLOPE)
38 ft
DRAINAGE
DITCH
2 ft
SLUDGE

(b) AFTER CLOSURE

Figure 24. Elevation view of Pond E.

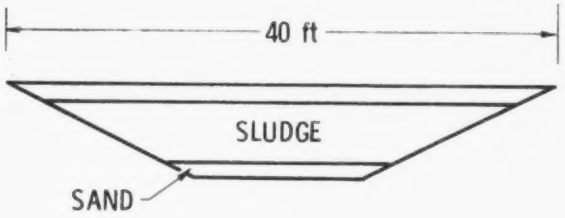

140 ft
38 ft
2: 1 SLOPE
LEACHATE WELL
PIER
SLUDGE LEVEL

(a) BEFORE CLOSURE

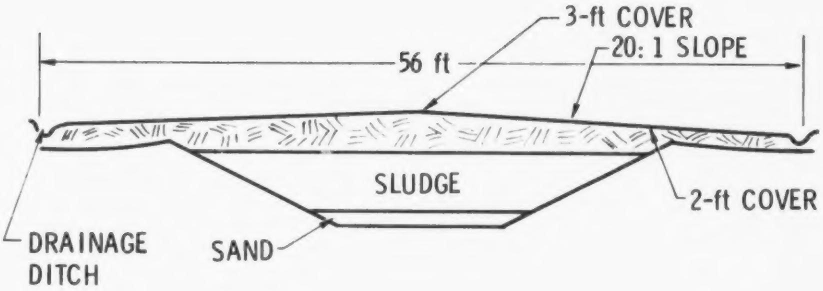

156 ft
20: 1 SLOPE
52 ft
DRAINAGE DITCH (FLOW INDICATED)

(b) AFTER CLOSURE

Figure 25. Plan view of Pond E.


40 ft
SLUDGE
SAND

(a) BEFORE CLOSURE


3-ft COVER
56 ft
20: 1 SLOPE
SLUDGE
2-ft COVER
DRAINAGE DITCH
SAND

(b) AFTER CLOSURE

Figure 26. Elevation view of Pond F.

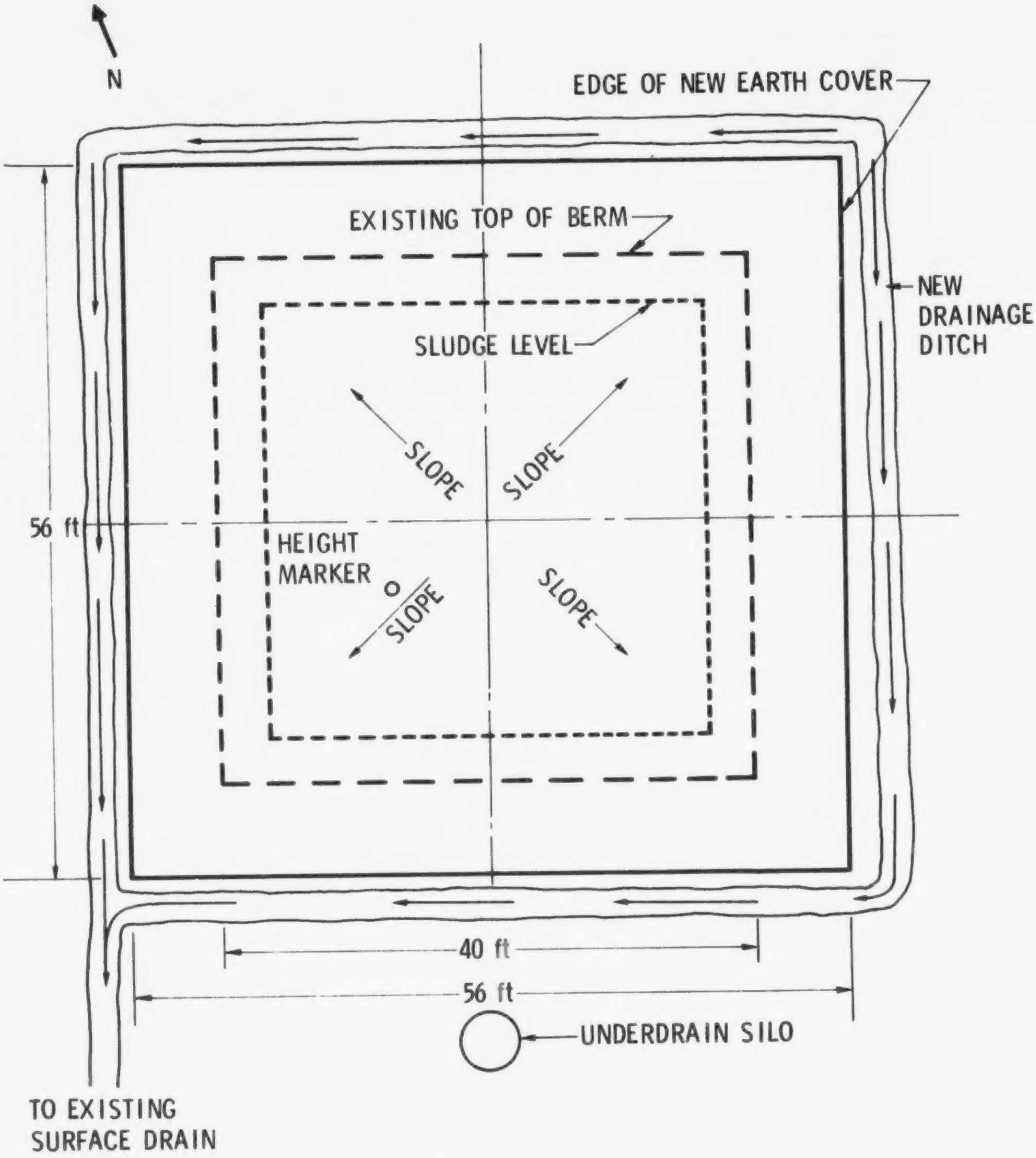

N
EDGE OF NEW EARTH COVER
EXISTING TOP OF BERM
NEW DRAINAGE DITCH
SLUDGE LEVEL
SLOPE
SLOPE
56 ft
HEIGHT MARKER
SLOPE
SLOPE
40 ft
56 ft
UNDERDRAIN SILO
TO EXISTING SURFACE DRAIN

Figure 27. Plan view of Pond F.

layer of straw and lightly watered to prevent wind erosion. In May 1978 and every 3 months thereafter, the grass layer was top-dressed with ammonium nitrate (34-0-0) at the rate of 2 to 3 lb/1000 ft^2 to maintain top cover growth.

7.4.3 Monitoring, Sampling, and Analysis

The leachate well in Pond E and the underdrain system in Pond F will continue to be monitored as previously, i.e., the water depth and/or meter reading will be taken weekly, and samples will be obtained and analyzed bimonthly as specified in the Test Plan (Ref. 8).

SECTION VIII

RESULTS OF ANALYSES

During this reporting period, analyses were continued on water samples from each pond, i.e., supernate (where applicable), leachate or underdrain, runoff (Pond H), and groundwater. Likewise, analyses were made on core samples (obtained by coring through the sludge and into the soil), as well as leachate obtained from these sludge cores during the permeability tests. Tests were also conducted on selected soil core samples removed from the pond bottoms and from virgin soil samples in the vicinity of the ponds, to ascertain the degree of penetration of soluble constituents from the sludge into the soil. In addition, climatological and hydraulic data, which are taken daily at the evaluation site, have been analyzed to investigate possible weather effects on sludge waters or structural properties. The results of this work are presented in the following paragraphs. A complete list of all the water analyses including the data presented below, is given in Appendix A. The procedures used in performing the chemical characterization and physical properties analyses are described in detail in Appendix B.

8.1 UNTREATED SLUDGE

There are five ponds at Shawnee which contain untreated sludge, i.e., Pond A1, lime absorbent, open ponding; Pond D, limestone absorbent, open ponding; Pond F, limestone absorbent, with underdrain; Pond G, lime absorbent, with underdrain; and Pond H, force-oxidized, limestone absorbent (gypsum) with underdrain. (The fill data on these ponds are contained in Section VII and summarized in Table 6 of that section.) Ponds A1 and D are considered control ponds since the open ponding of untreated sludge in soil indigenous to the disposal site represents the simplest and least expensive disposal option.

8.1.1 Pond A1 (Lime Absorbent)

Pond A was originally located west of the power plant and was discontinued in April 1976, when the area was needed for the expansion of the coal pile. Sludge from Pond A was transferred to a new site (Pond A1), adjacent to the other ponds, in May 1976. A new groundwater well was constructed at Pond A1 in the spring of 1977 and has been monitored since that time. The results of the analyses of water from both the old and new groundwater wells for Pond A/A1 are shown in Figure 28. The concentration of dissolved solids in the groundwater shows a gradual decline over the first three years, with a temporary increase in TDS, calcium, and chloride concentrations near the end

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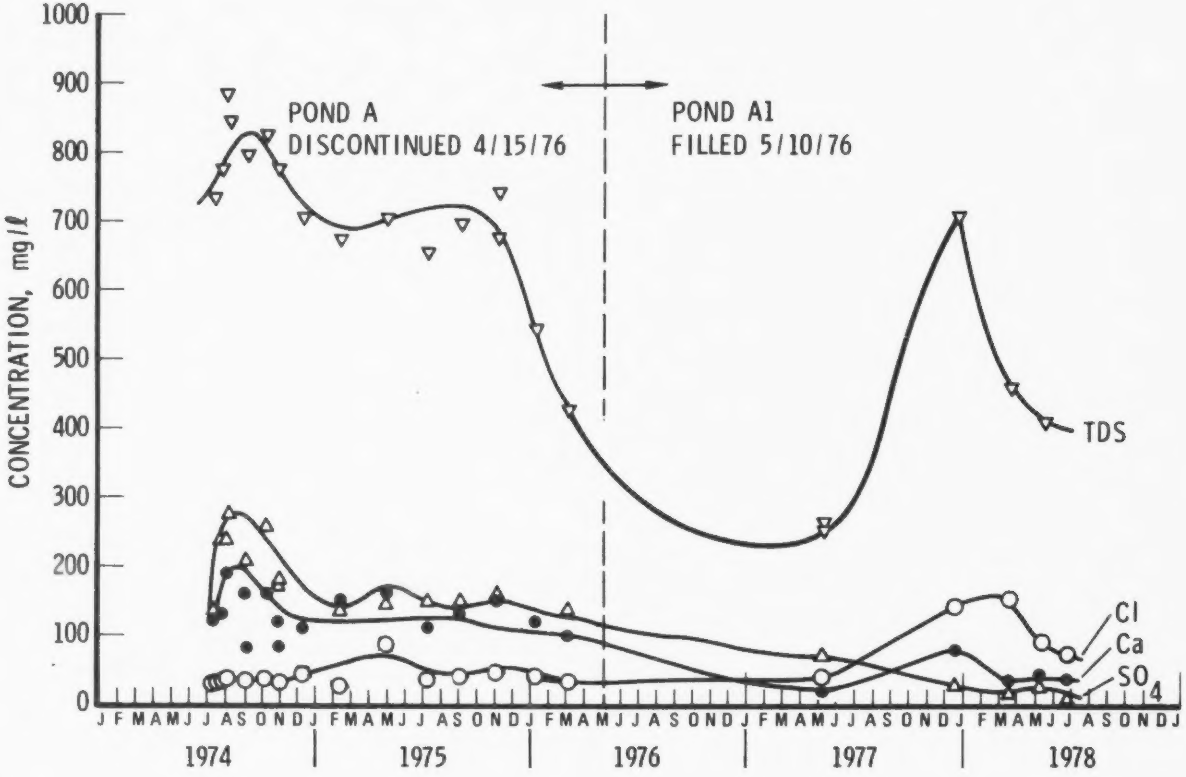

Figure 28. Concentration of TDS and major species in Pond A/A1 groundwater.

of 1977; however, this increase is not reflected in the sludge leachate concentration of TDS. Typical TDS concentrations in the groundwater wells, which were constructed and monitored prior to initiation of any of the disposal ponds (i.e., in the vicinity of Ponds B, C, and E discussed in subsequent sections), are approximately 400 mg/ℓ. Typical TDS concentrations in Pond A/A1 groundwater well, as well as all other groundwater wells, were in the range of 300 to 450 mg/ℓ throughout the entire evaluation program. Thus, it appears that the sludge did not have any effect on the concentration of dissolved constituents in the groundwater. Occasionally, single data points were obtained showing groundwater TDS concentrations at variance with typical values (e.g., 150 and 900 mg/ℓ); however, these concentrations were short-lived and subsequent values were in the typical value range.

The concentration of dissolved solids and major constituents in the supernate of Pond A/A1 were found to fluctuate as a result of rainfall and evaporation, which is typical of supernate in all of the ponds. Over a 3-1/2-year monitoring period, a gradual decrease of peak values of concentration in TDS and major constituents has been observed and by mid-1978 the TDS concentration dropped to less than 1000 mg/ℓ, as compared to a concentration of close to 6000 mg/ℓ in 1974 shortly after pond filling (Figure 29).

When Pond A was filled in 1974, the TDS concentration in the leachate quickly increased to a level equivalent to the TDS concentration in the input liquor. Since that time, the TDS concentration has steadily decreased (Figure 30). With the exception of the sulfate concentration, which has remained relatively constant throughout the 4-year monitoring period, the major constituents in the leachate also decreased steadily. When the sludge material was transferred from Pond A to Pond A1 in 1976, there was no discernible change in the decreasing trend of the TDS level. By mid-1978 the TDS concentration had dropped to a level of approximately 2300 mg/ℓ; the chloride was virtually depleted; the calcium concentration had dropped to approximately 800 mg/ℓ; and the sulfate concentration remained at a level of approximately 1400 mg/ℓ.

The analyses of minor species in the Pond A/A1 leachate show that the concentrations of boron, lead, selenium, and mercury have remained relatively constant since pond filling, whereas the concentrations of magnesium and arsenic have declined gradually. The concentrations of these minor species plotted as a function of time are shown in Figure 31.

8.1.2 Pond D (Limestone Absorbent)

The analyses of the groundwater associated with Pond D consistently show a somewhat higher concentration of chloride and TDS than the groundwater associated with the other disposal ponds. The calcium and sulfate concentrations have remained at a low level (less than 200 mg/ℓ) over the 4-year monitoring period, while the chloride has fluctuated slightly around 300 mg/ℓ (Figure 32). The dissolved constituents in the Pond D leachate have shown a decreasing trend since 1975, particularly chloride, which is now virtually depleted. Therefore, it appears that the fluctuation in the level

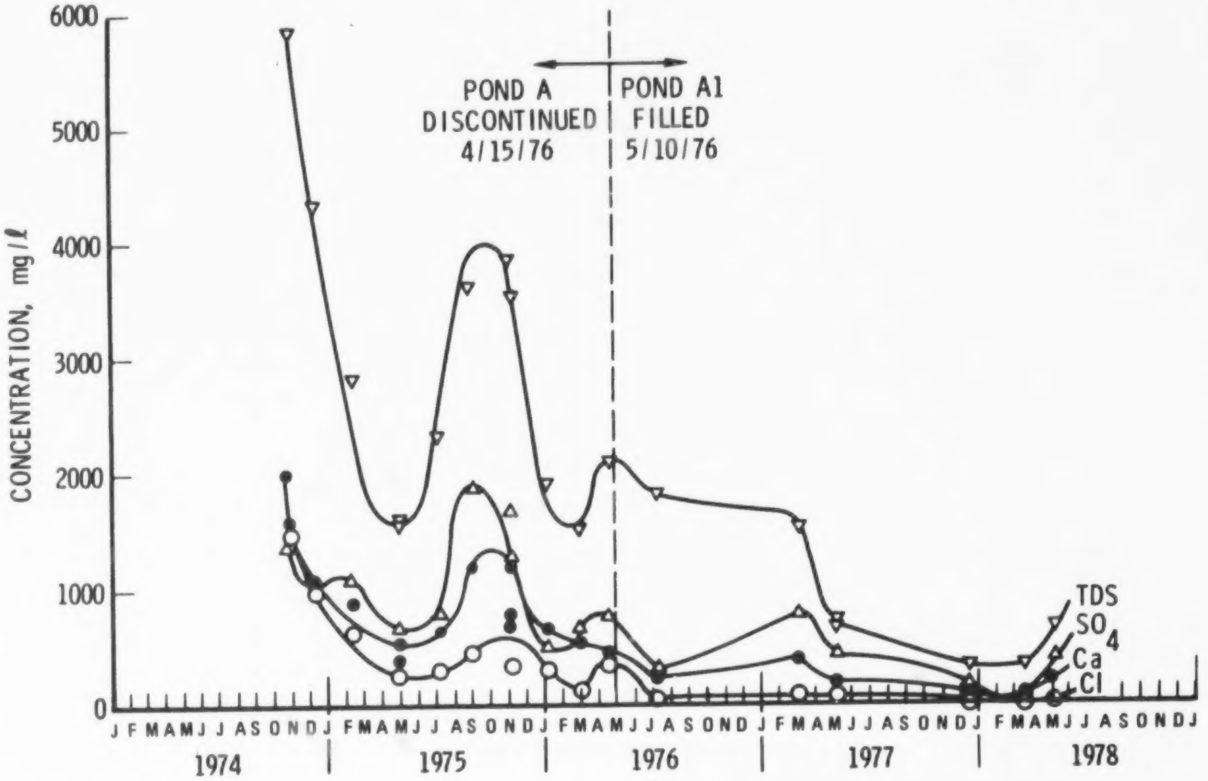

Figure 29. Concentration of TDS and major species in Pond A/A1 supernate.

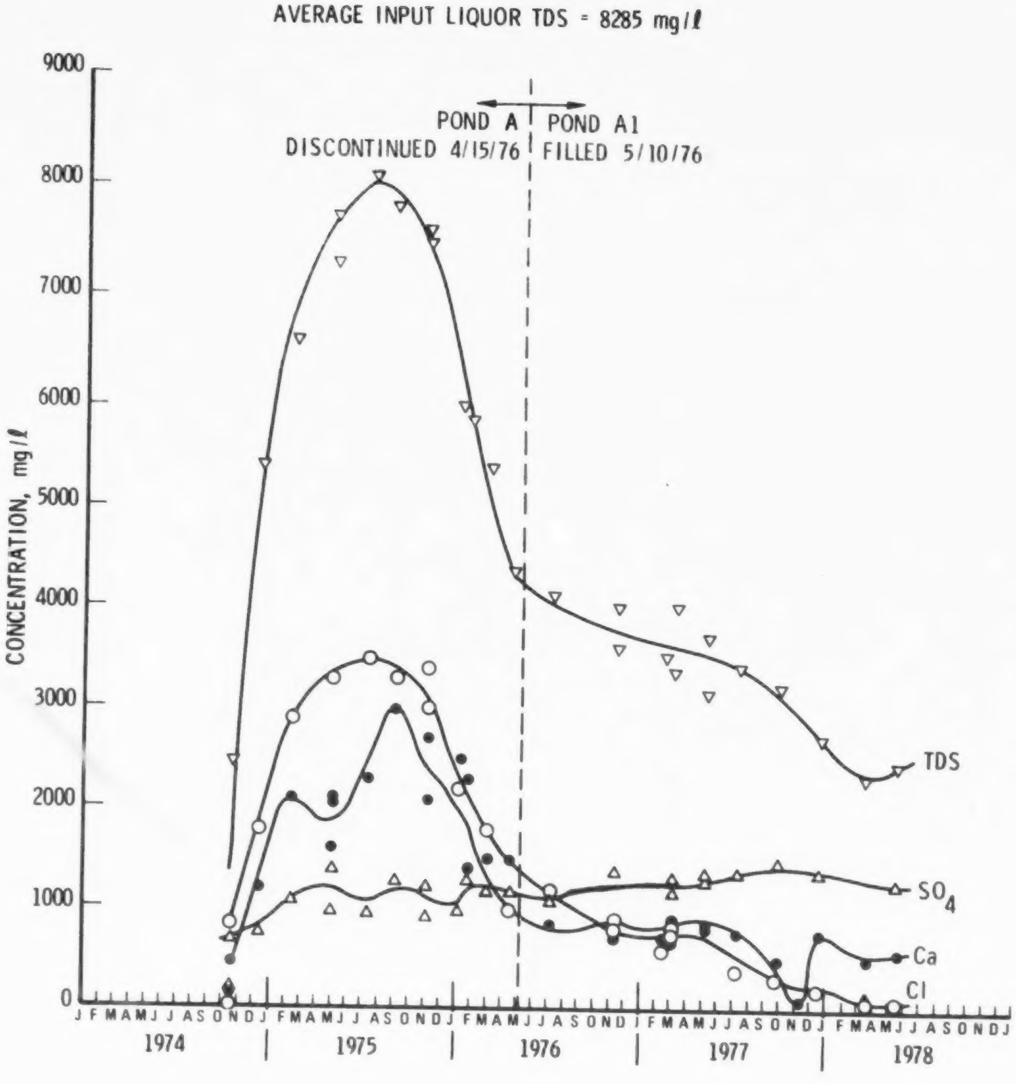

Figure 30. Concentration of TDS and major species in Pond A/A1 leachate.

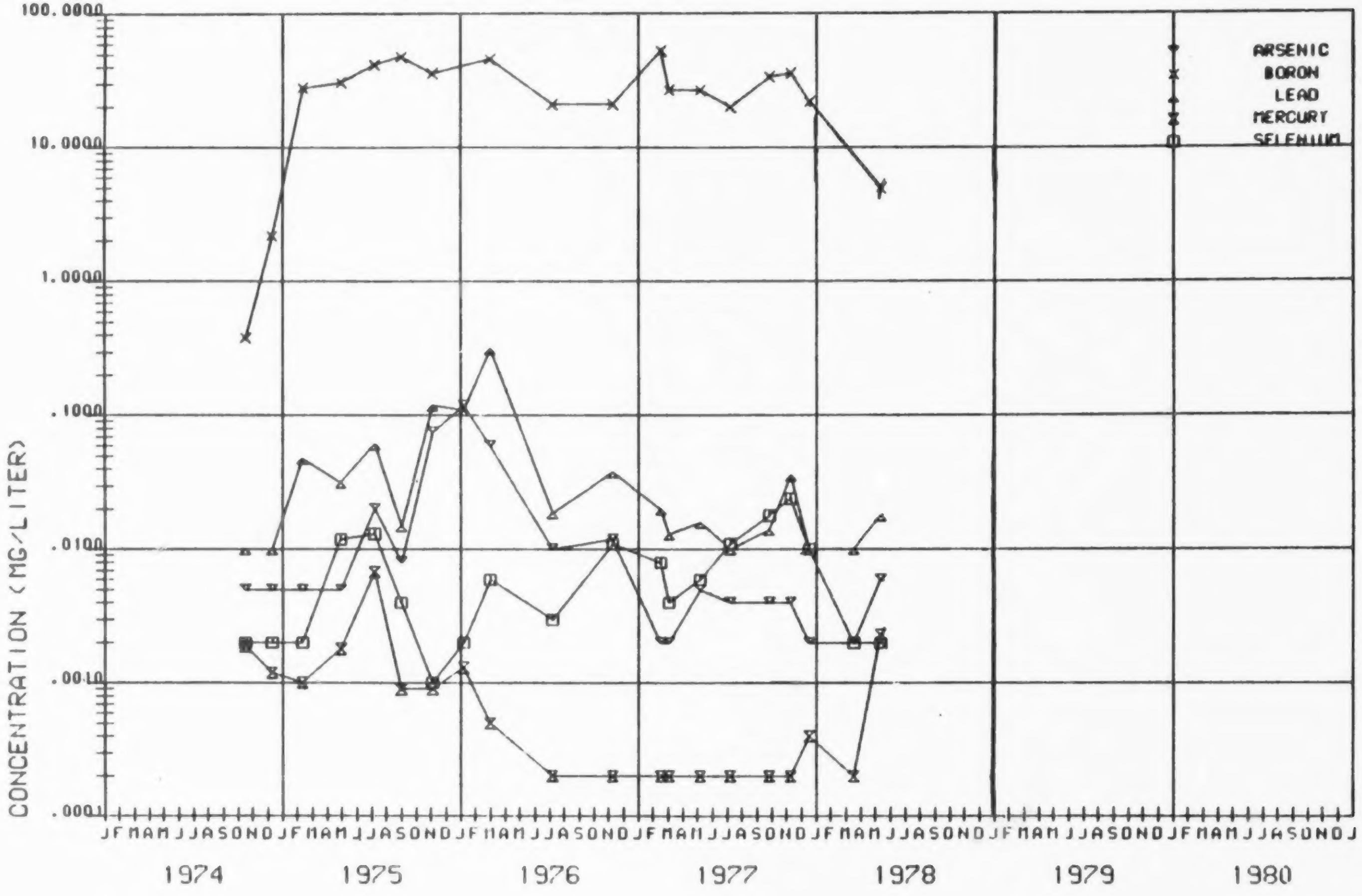

Figure 31. Concentration of minor species in Pond A/A1 leachate.

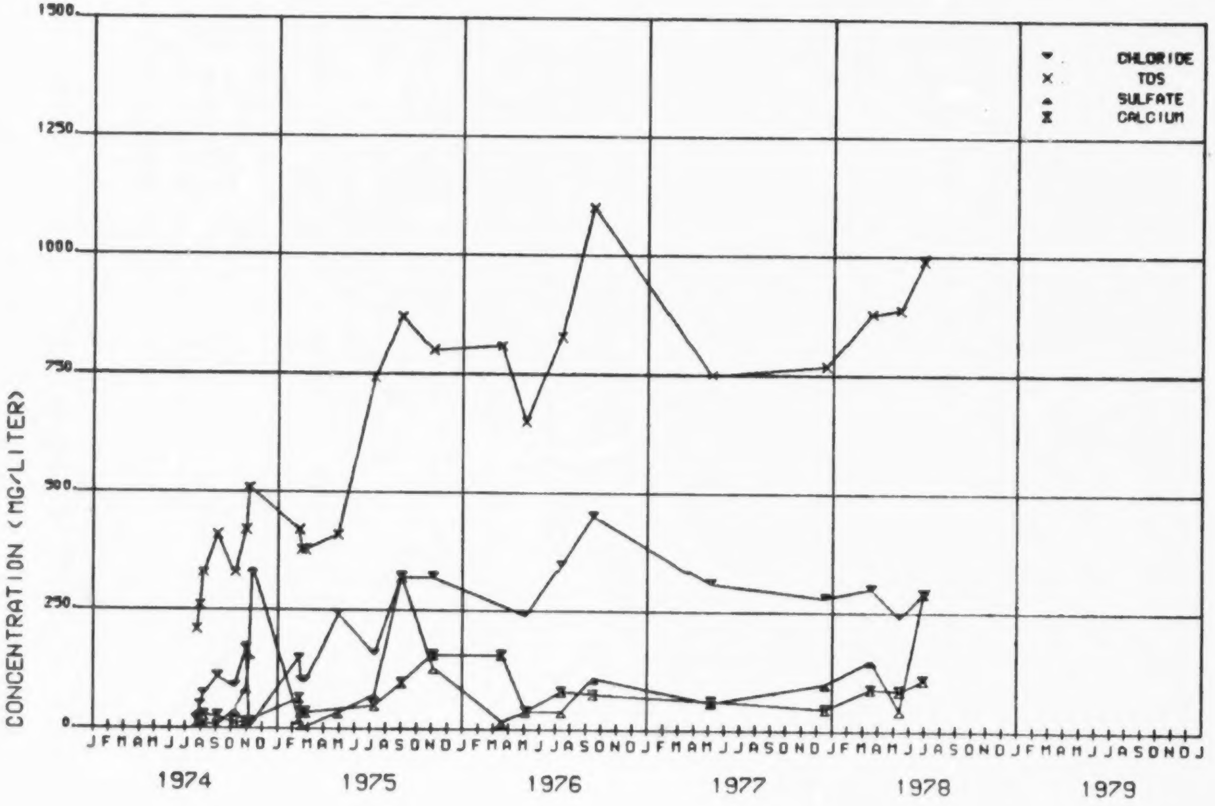

Figure 32. Concentration of TDS and major species in Pond D groundwater.

of dissolved solids in the groundwater is not a result of water from the pond. In mid-1978, at the end of the current monitoring period, the TDS and sulfate concentrations in the groundwater have shown a peak in concentration similar to that experienced during mid-1976. However, subsequent data suggest that this increase is reflecting a temporary condition.

The concentrations of TDS and major constituents in the supernate of Pond D exhibit seasonal variations characteristically found in other ponds at Shawnee (Figure 33). Over the 3-1/2-year monitoring period since 1974, the peak concentrations of TDS in these cycles have gradually diminished, and in mid-1978 dropped below 2000 mg/ℓ. Sulfate is the main dissolved constituent, at 1000 mg/ℓ with calcium showing less than 500 mg/ℓ, and the chloride virtually depleted.

The leachate in Pond D also showed a decrease in TDS immediately after pond filling, and by the end of this reporting period had dropped to 2300 mg/ℓ from a value of just over 5000 mg/ℓ in late 1974 (plotted in Figure 34). The chloride in the sludge is also virtually depleted, leaving sulfate as the main constituent (1500 mg/ℓ), and calcium at a level less than 1000 mg/ℓ. The six minor species monitored in the Pond D leachate have shown a slight decrease in magnesium and boron concentrations, whereas the concentrations of arsenic, selenium, lead, and mercury remained relatively constant except for slight seasonal variations. A plot of the results of the analyses for minor species in the Pond D leachate is shown in Figure 35.

A plot of the Pond D leachate and supernate concentration, with weekly precipitation as a function of time is given in Figure 36. Although a direct correlation of supernate with rainfall cannot be made because of the effects of dilution, evaporation, and periodic drawdown by the site maintenance crew to prevent flooding of the access pier and the leachate well, the fluctuation of supernate with weather is evident. More significantly, it can be seen that the leachate is independent of supernate concentration after 1975 when the chloride is diminished to an insignificant value (Figure 34) and the leachate is governed by sulfate solubility. During early 1975, the relatively high values of chloride affected the leachate and supernate concentrations although it is not obvious that the supernate was affecting leachate concentrations during that period. No correlation can be shown during the initial period (late 1974) because the leachate was diluted by rainwater which existed in the leachate well when the pond was originated (naturally occurring water was allowed to remain in the well to simulate actual field conditions as much as possible).

8.1.3 Pond F (Underdrained, Limestone Absorbent)

The groundwater from the two wells associated with Pond F has been analyzed since March 1977, shortly after the pond was filled. Typical results of these analyses, as plotted in Figure 37, show a TDS level of approximately 400 to 500 mg/ℓ, chloride levels of approximately 100 mg/ℓ or less, calcium at 50 mg/ℓ, and a sulfate concentration of less than 20 mg/ℓ. Results from the

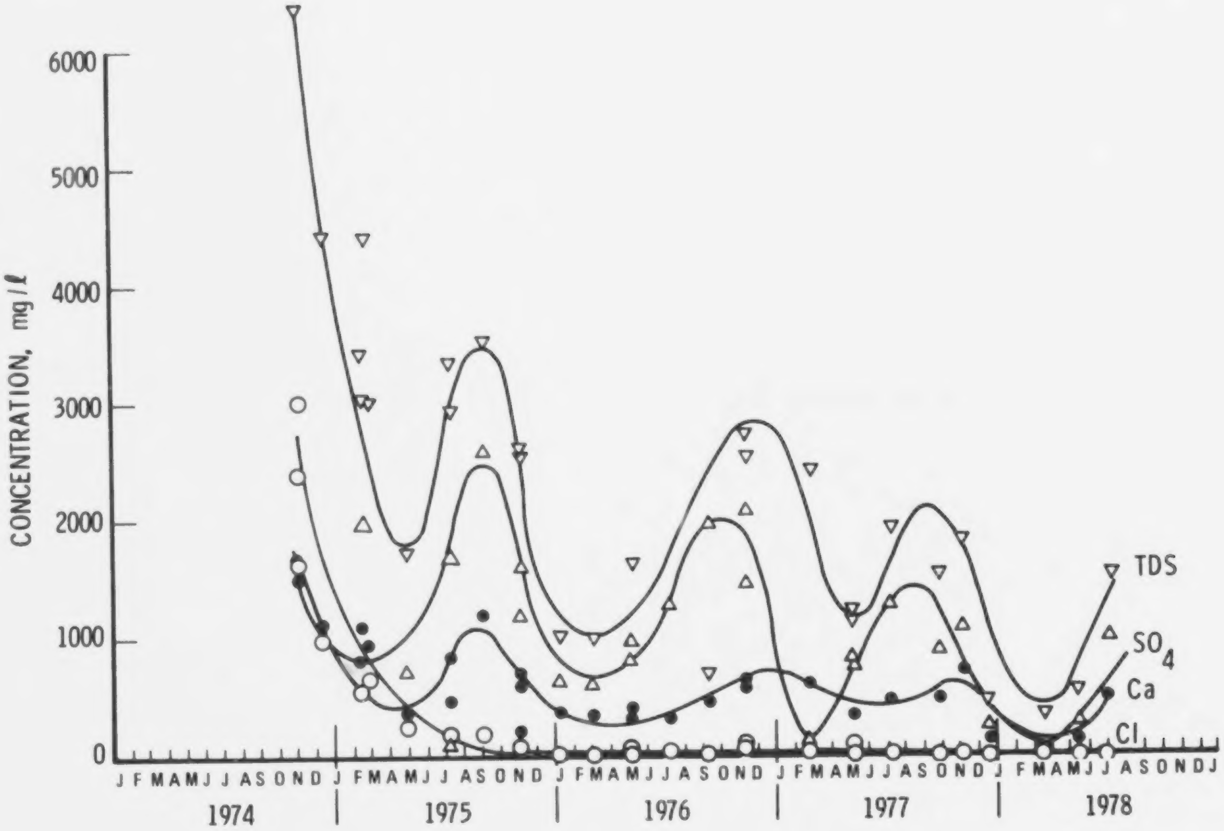

Figure 33. Concentration of TDS and major species in Pond D supernate.

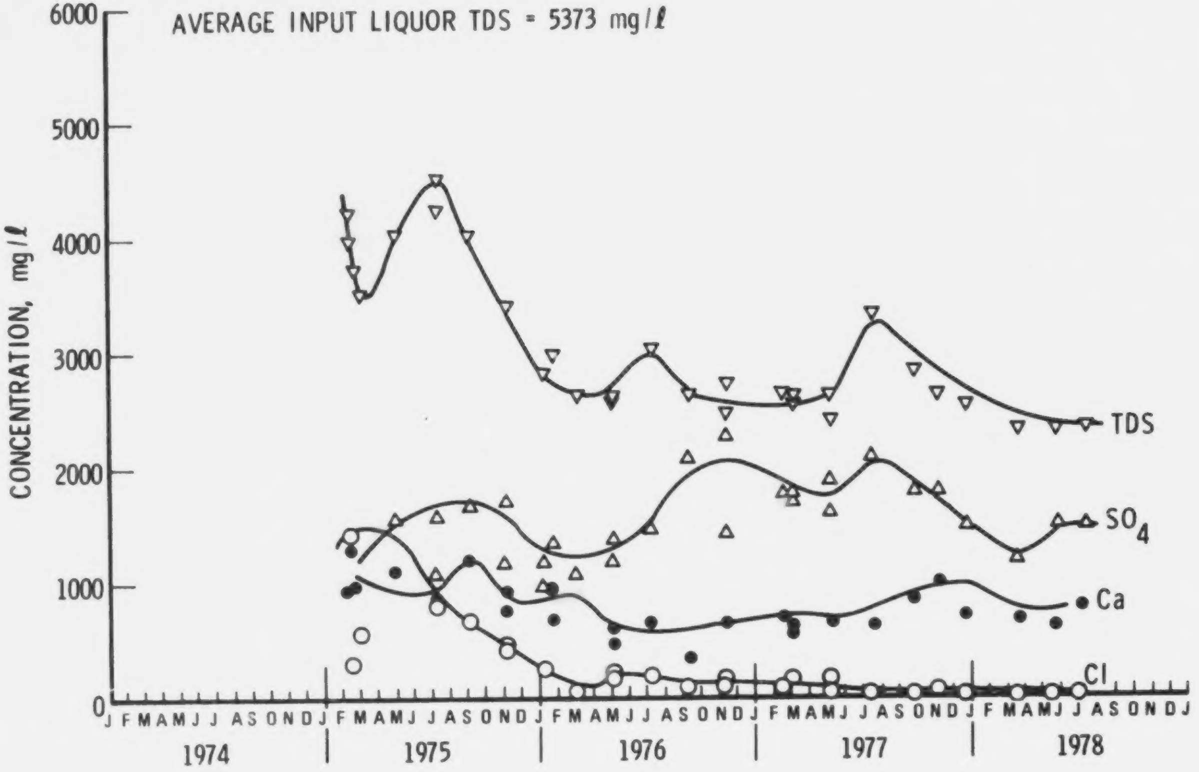

Figure 34. Concentration of TDS and major species in Pond D leachate.

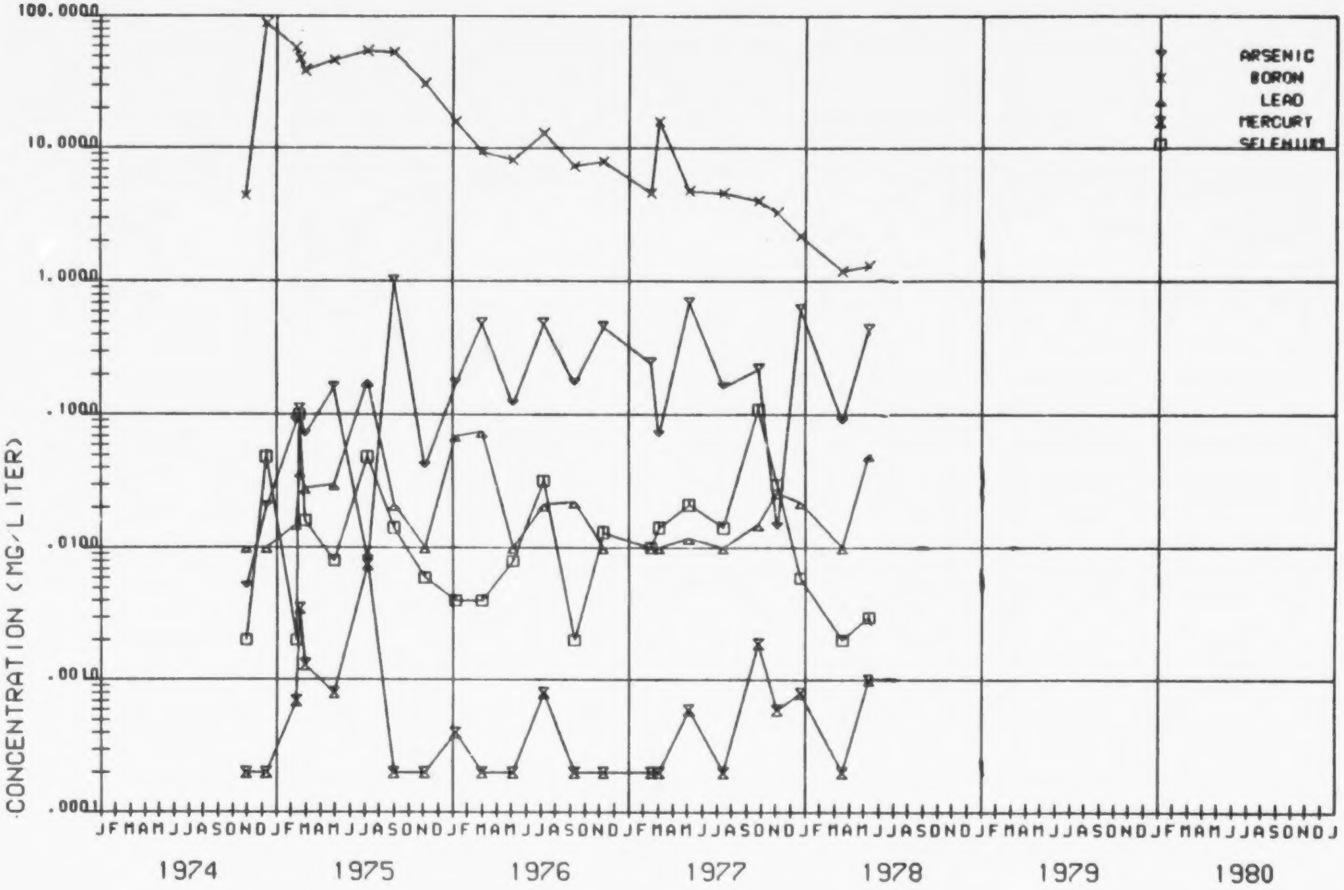

Figure 35. Concentration of minor species in Pond D leachate.

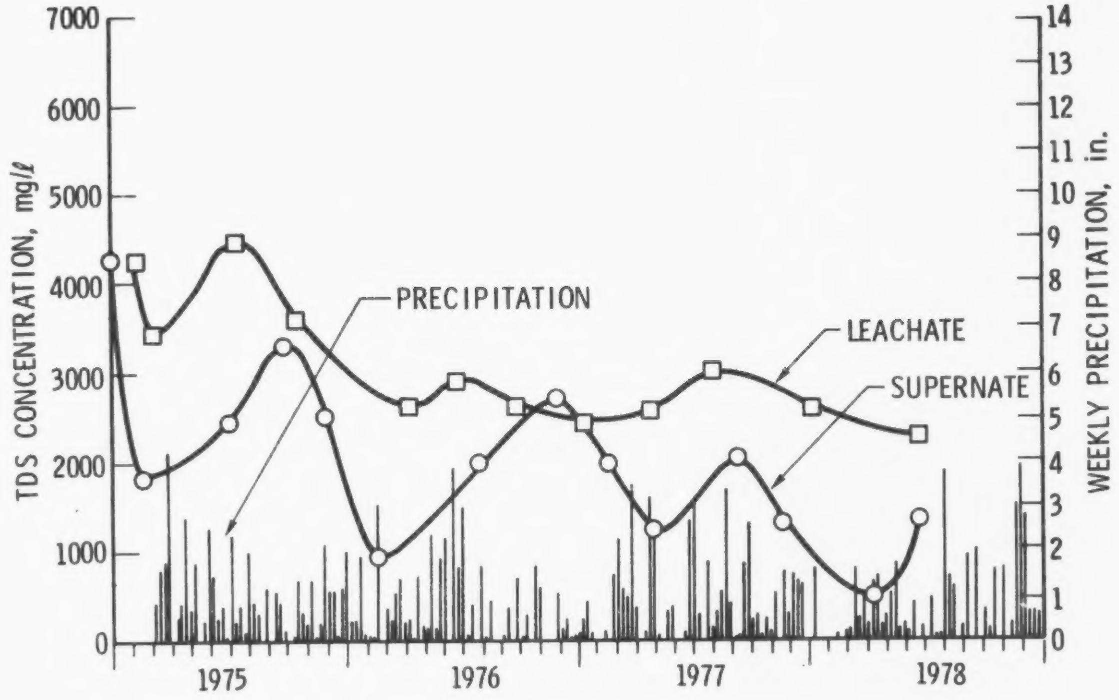

Figure 36. Concentration of TDS in Pond D leachate and supernate with rainfall.

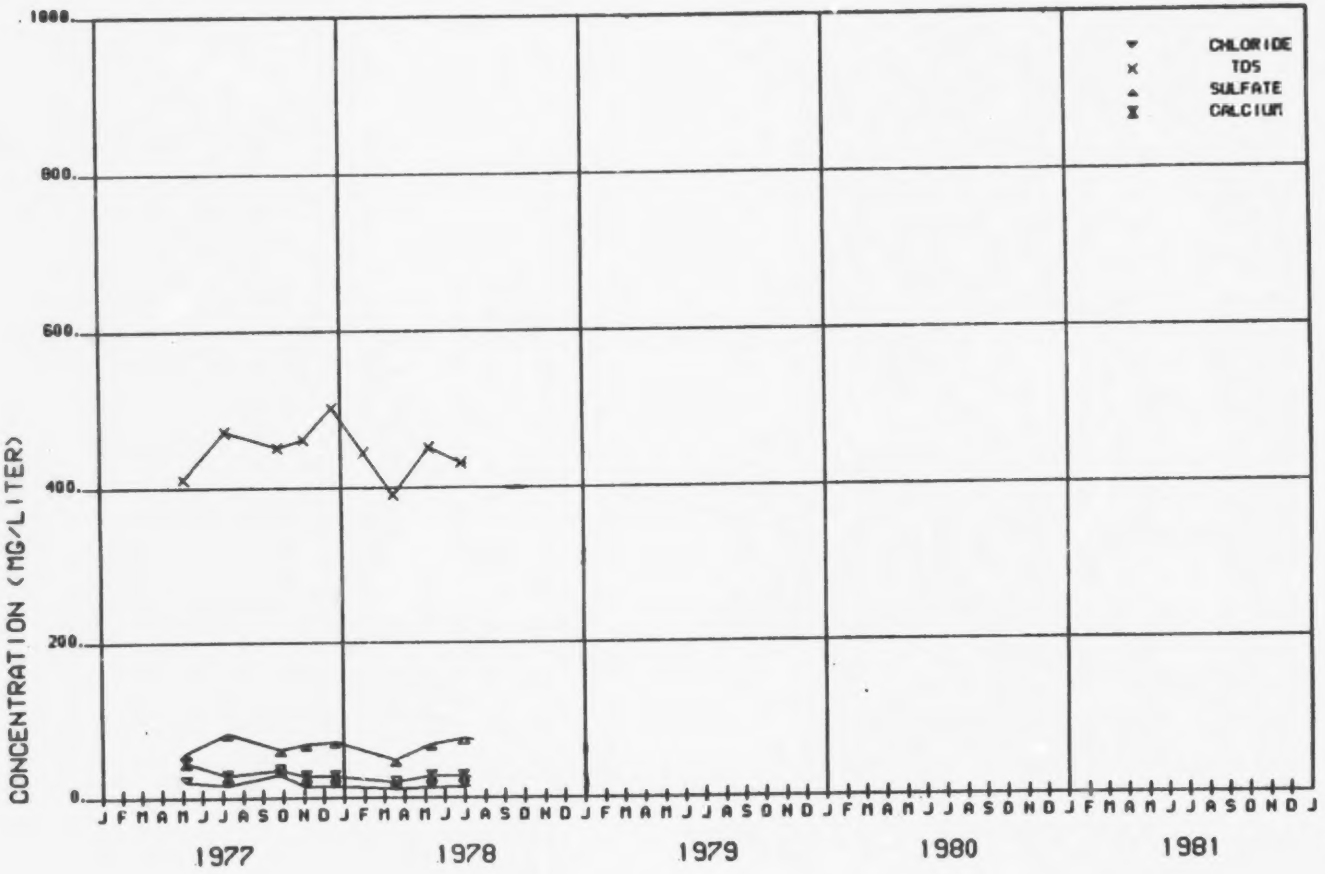

Figure 37. Concentration of TDS and major species in Pond C groundwater.

analyses for six minor constituents also show no sign of unusual concentrations or trends. Therefore, it appears that there have been no effects on the groundwater as a result of dissolved constituents from the pond since (1) the base is above 40 ft of highly "impermeable" clay, (2) the pond was exposed to rain only nine months, and (3) there is a negligible hydraulic head on this underdrained pond.

Analyses of the underdrain water from Pond F show that the TDS concentration dropped from an input value of 6700 mg/ℓ (Table 9) to approximately 4000 mg/ℓ within 3 months after the pond was filled (data plotted in Figure 38). Thereafter, the TDS concentration remained essentially constant at a level of approximately 4000 mg/ℓ for a period of 6 additional months until the pond was retired in November 1977. The pond has remained closed, and in May 1978 an analysis of an underdrain sample showed the TDS concentration down to a level of 980 mg/ℓ. This last data point may be a spurious test point, however, since the underdrain system was turned off at the time of pond closure and there was little or no drainage through the sludge to cause such a drastic reduction in the TDS concentration. In any event, the underdrain mode shows a rapid drop in dissolved constituents as compared to ponds not equipped with underdrain systems. Of the six minor species monitored in the underdrain water, arsenic, boron, lead, and mercury remained at rather constant concentrations throughout, while magnesium showed an increase and selenium a decrease in concentration (Figure 39 and Appendix A).

8.1.4 Pond G (Underdrained, Lime Absorbent)

The groundwater wells for Pond G were monitored from mid-1976 to mid-1978 and show TDS concentrations of approximately 600 mg/ℓ, or less, throughout this 2-year period (Figure 40). These concentrations are typical of those found in the groundwater wells of the other ponds in the area. The six minor species also showed no unusual concentrations or trends. Thus, it appears that there has been no effect on the groundwater as a result of underdrain water in the pond.

The TDS concentration in the input liquor for Pond G showed an average of 14,000 mg/ℓ, and analyses of the underdrain water show that within 6 months after filling the TDS concentration had dropped to levels between 2200 and 4300 mg/ℓ. During the last 9 months of the monitoring period, from September 1977 to June 1978, the TDS concentration decreased gradually from 2900 mg/ℓ to 2300 mg/ℓ (Figure 41). The six minor species monitored in the Pond G underdrain showed no unusual concentrations or discernible trends (Figure 42) when compared with other sludges.

8.1.5 Pond H (Underdrained, Ash-Free Gypsum)

Pond H was filled with ash-free gypsum (both clarifier underflow and filter cake) during August and September 1977 (Section 7.1.2). The groundwater wells associated with Pond H were constructed and monitored prior to pond filling, i.e., GWH2 in July 1976 and GWH1 in May 1977. The results of the analyses conducted through mid-1978 show a TDS concentration of between

TABLE 9. INPUT LIQUOR ANALYSIS

Pond	Sludge Type	Solids Content, %	pH	Concentration, mg/ℓ												
				Ca	SO_4	Cl	SO_3	TDS[a]	As	B	Pb	Mg	Na	Se	Hg	COD[b]
A	Lime, filter cake	46	8.3	2100	1525	4600	4	8560	0.024	44	0.49	290	--	0.005	<0.0001	--
B	Limestone, clarifier underflow	38	8.9	1060	1875	1850	3	5160	0.004	97	<0.02	2.5	17	0.020	0.0024	140
C	Lime, centrifuge cake	55	8.9	2720	1575	4700	45	9240	0.002	34	<0.01	33	46	0.018	<0.0001	140
D	Limestone, clarifier underflow	38	9.2	1880	1500	2950	56	6750	0.004	93	<0.02	50	56	0.014	0.0003	130
E	Limestone, clarifier underflow	38	9.4	1880	1400	2700	32	6190	0.004	80	<0.01	12	41	0.014	0.00033	110
F	Limestone, clarifier underflow, flyash remixed	47	12.2	1990	1100	2000	--	6700	0.002	76	<0.01	0.3	70	0.042	<0.0002	43
G	Lime, centrifuge cake, flyash remixed and layered	47	7.8	150	6600	3600	--	14000	0.14	93	<0.01	5000[c]	12	0.63	<0.0002	53
H	Limestone, gypsum clarifier underflow	33	--	1110	1930	3500	--	9200	--	120	--	540	62	--	--	--
H	Limestone, gypsum filter cake	86	--	1510	1875	6600	--	10756	--	140	--	1100	116	--	--	--

[a] Total dissolved solids.

[b] Chemical oxygen demand.

[c] Magnesia added to lime absorbent.

--Not determined.

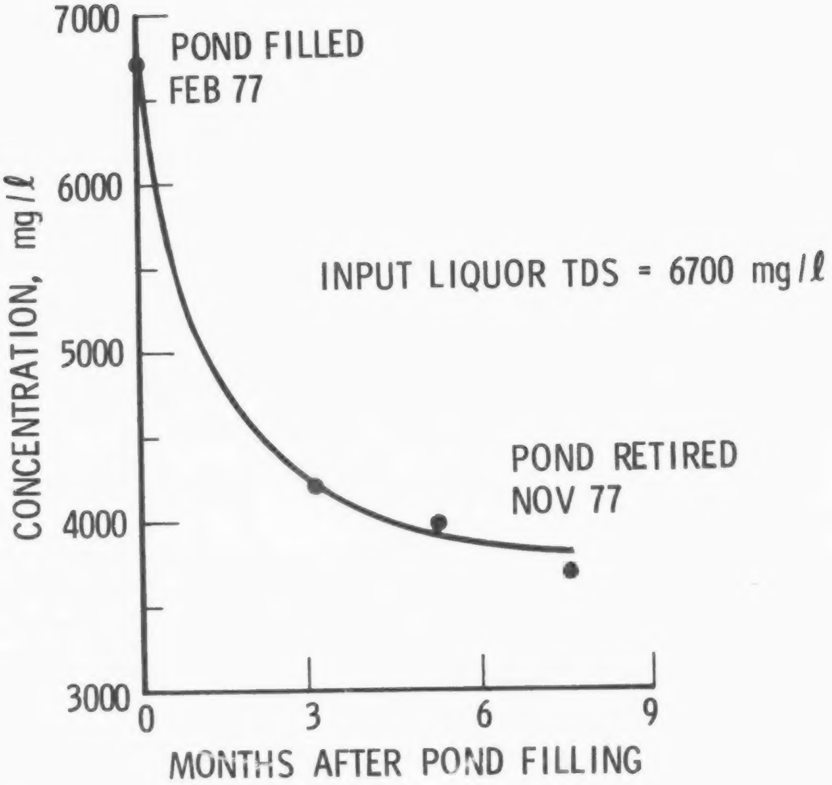

Figure 38. Concentration of TDS in Pond F underdrain water.

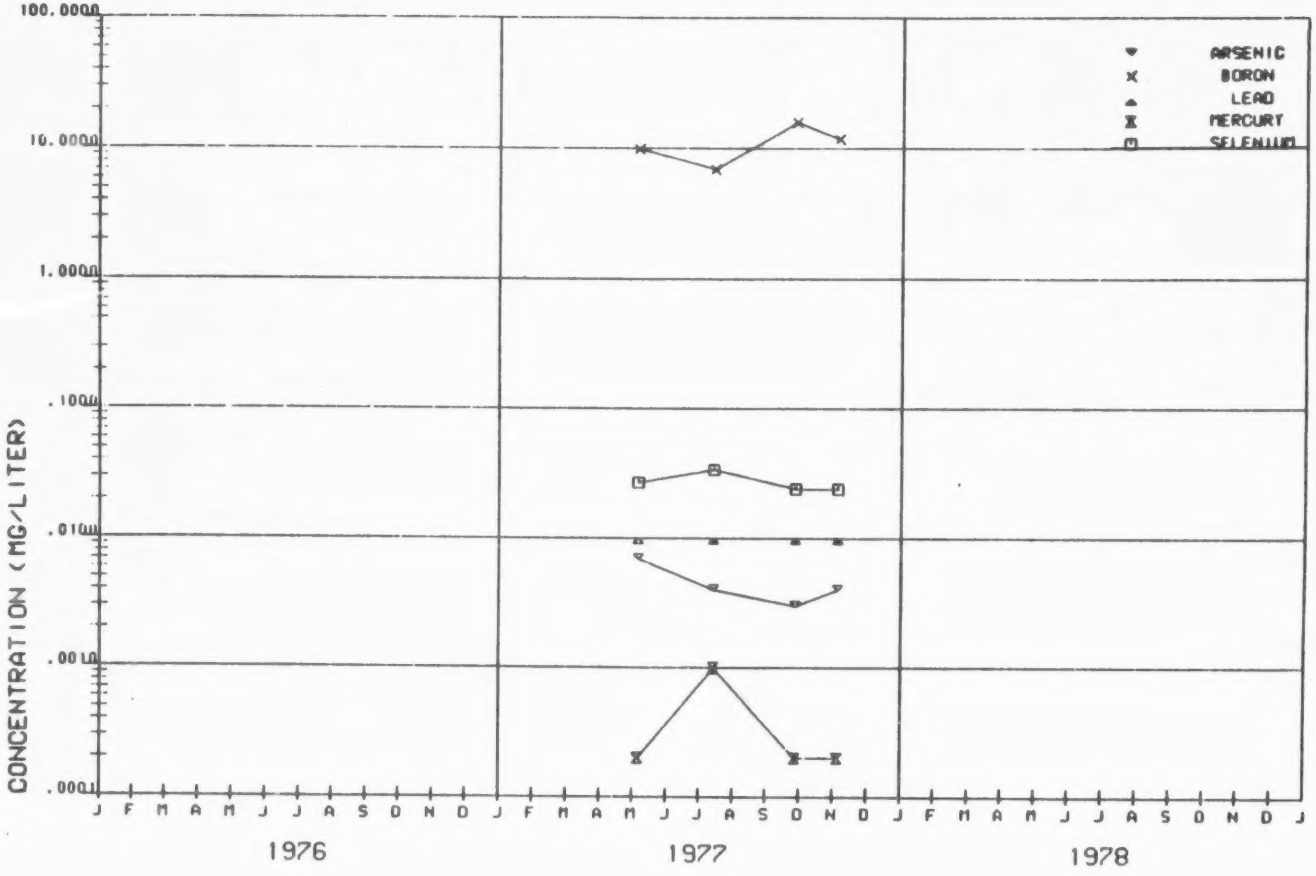

Figure 39. Concentration of minor species in Pond F underdrain.

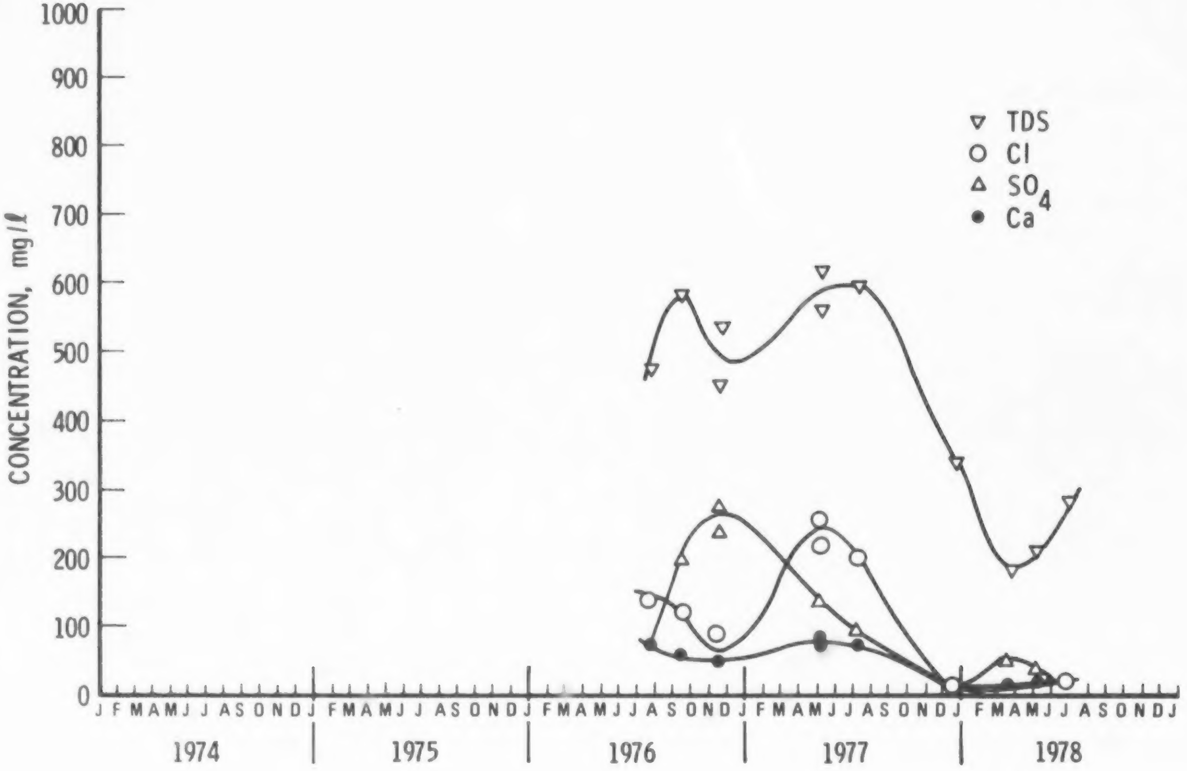

Figure 40. Concentration of TDS and major species in Pond G groundwater.

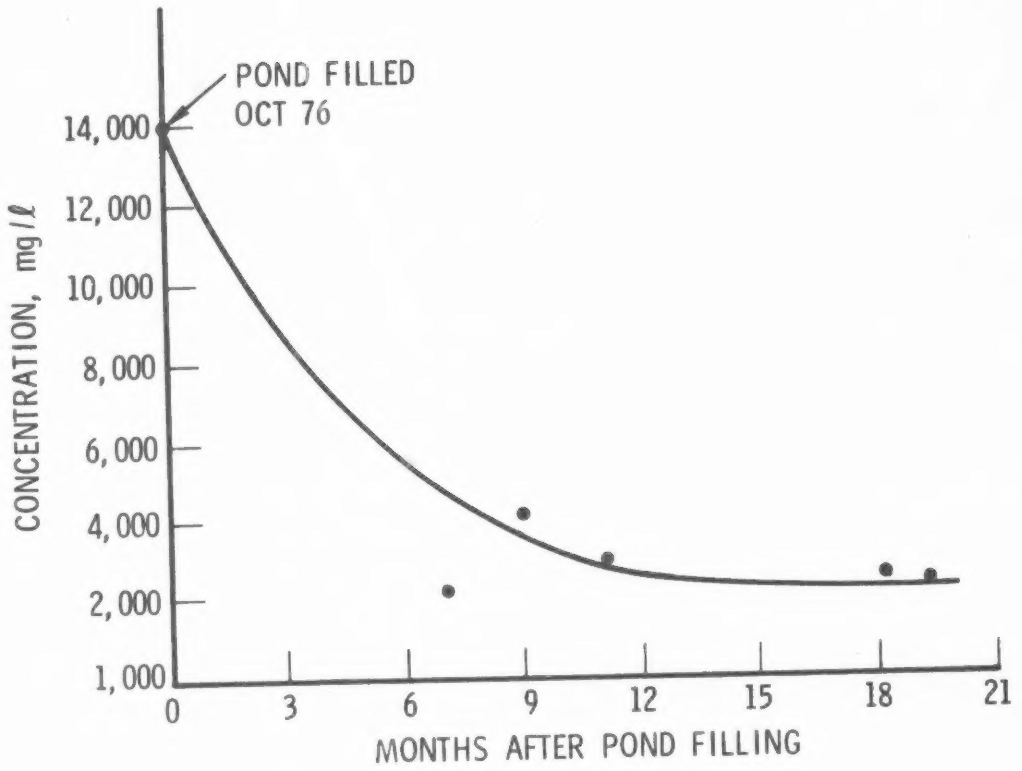

Figure 41. Concentration of TDS in Pond G underdrain.

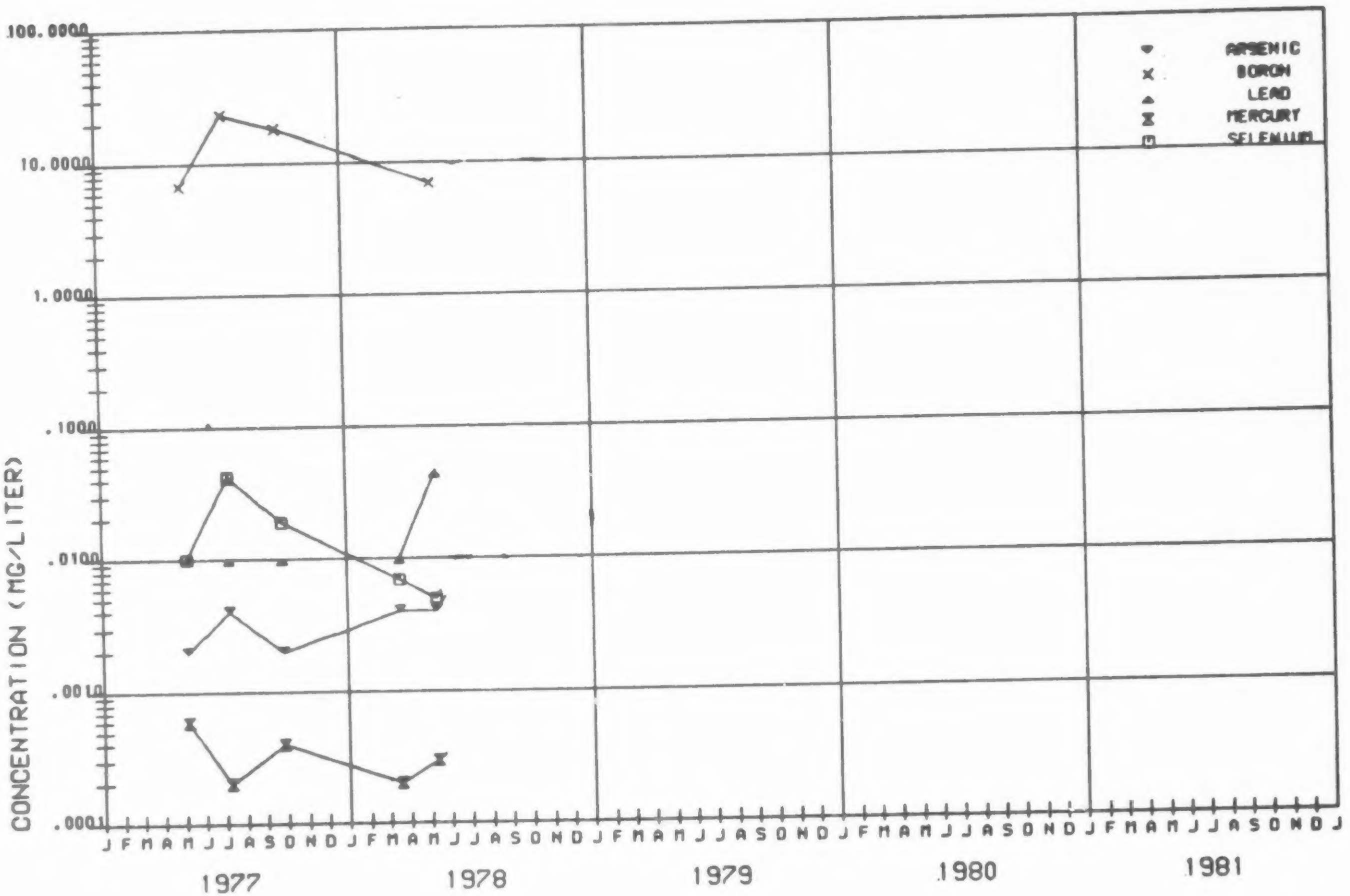

Figure 42. Concentration of minor species in Pond G underdrain.

300 and 450 mg/ℓ, with a corresponding steady level of dissolved constituents (Figure 43). The six minor constituents likewise show no unusual trends or concentrations. This suggests that the underdrain water has had no discernible effect on the groundwater beneath Pond H, as expected.

Inasmuch as Pond H has both gypsum clarifier underflow in the underdrained portion of the pond topped with 122 yd^3 of gypsum filter cake, both underdrain and runoff are sampled and analyzed. When the pond was filled with clarifier underflow in August 1977, the average TDS concentration in the input liquor was 9200 mg/ℓ; the filtrate sampled in September 1977 showed a TDS concentration of 10,786 mg/ℓ. The underdrain water showed a sharp decrease in the TDS concentration within a 2-month interval, and after 9 months of monitoring the TDS level had dropped to 3500 mg/ℓ. The runoff showed a TDS concentration of between 2500 and 3200 mg/ℓ within 2 months after pond filling and lasting through mid-1978 (Figure 44). However, the runoff showed a wide variation in TSS, with values ranging between 4 and 309 mg/ℓ. This variation is to be expected as filter cake material erodes from weathering and fresh material is periodically exposed to rainfall. The results of the analyses of six minor species in the Pond H underdrain water are shown in Figure 45. Arsenic, lead, and mercury remain at near constant levels during the 10 months of monitoring after the pond was filled. Boron and magnesium concentrations show variations by a factor of 2 or 3, but both show a slight decreasing trend from their respective levels in the input liquor. Selenium shows a gradually decreasing concentration, and by mid-1978 had dropped an order of magnitude from the initial level at the time of pond filling 10 months earlier. A summary of typical concentrations of major and minor species in Pond H underdrain and runoff samples is shown in Table 10. These samples were taken between March and June 1978, roughly 6 months after placement of the gypsum sludge in the pond.

8.1.6 Physical Characteristics

The physical properties considered in the disposal of FGD sludges include bulk density, water retention characteristics, load-bearing strength, porosity, permeability, and viscosity. The latter is important in the transport of the sludge to a disposal site, and the others concern the weight and volume of the disposal material, as well as the suitability of the waste as a load-bearing material and deterrent to seepage in a disposal site.

The physical properties of FGD sludges are dependent upon the characteristics of both the liquid and the solid constituents, as well as the interaction between them. The lime and limestone scrubber wastes contain four principal crystalline phases: calcium sulfite, calcium sulfate, fly ash, and unreacted limestone or precipitated calcium carbonate. In many cases, the sulfite phase also contains small fractions of sulfate crystals. However, the presence of the sulfate has not yet been found to affect the basic properties of the sludge.

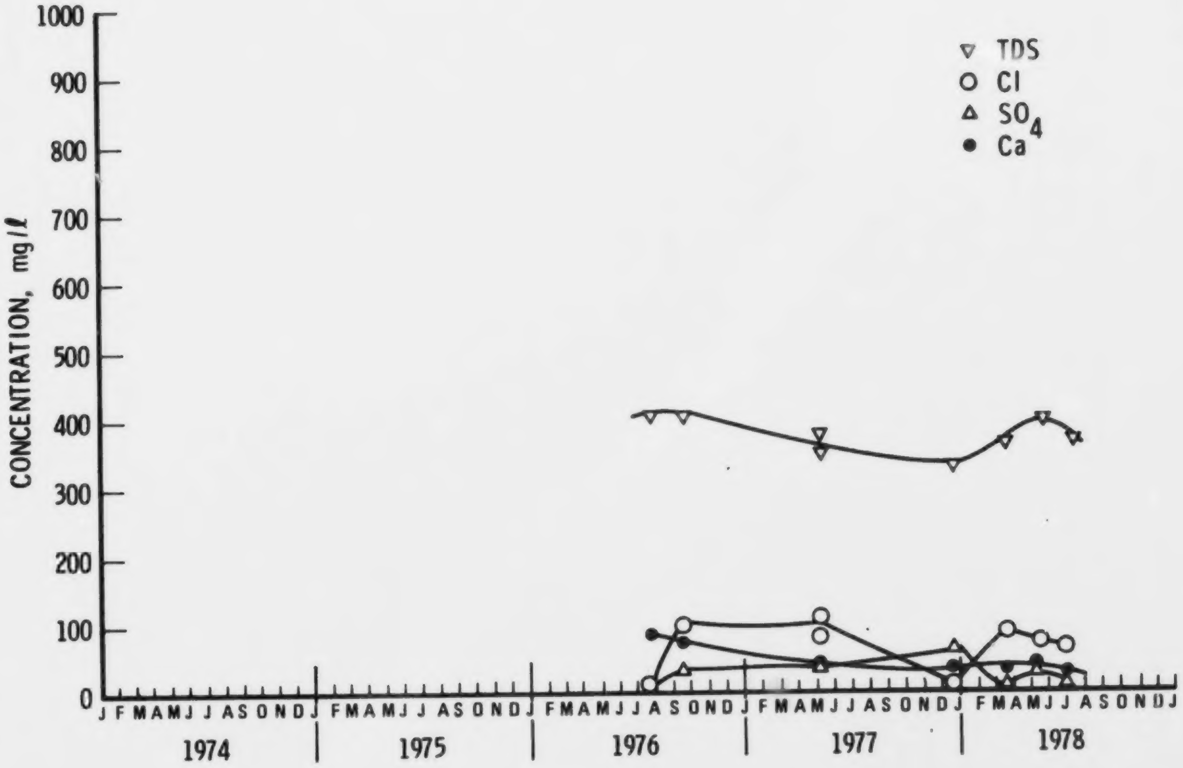

Figure 43. Concentration of TDS and major species in Pond H groundwater.

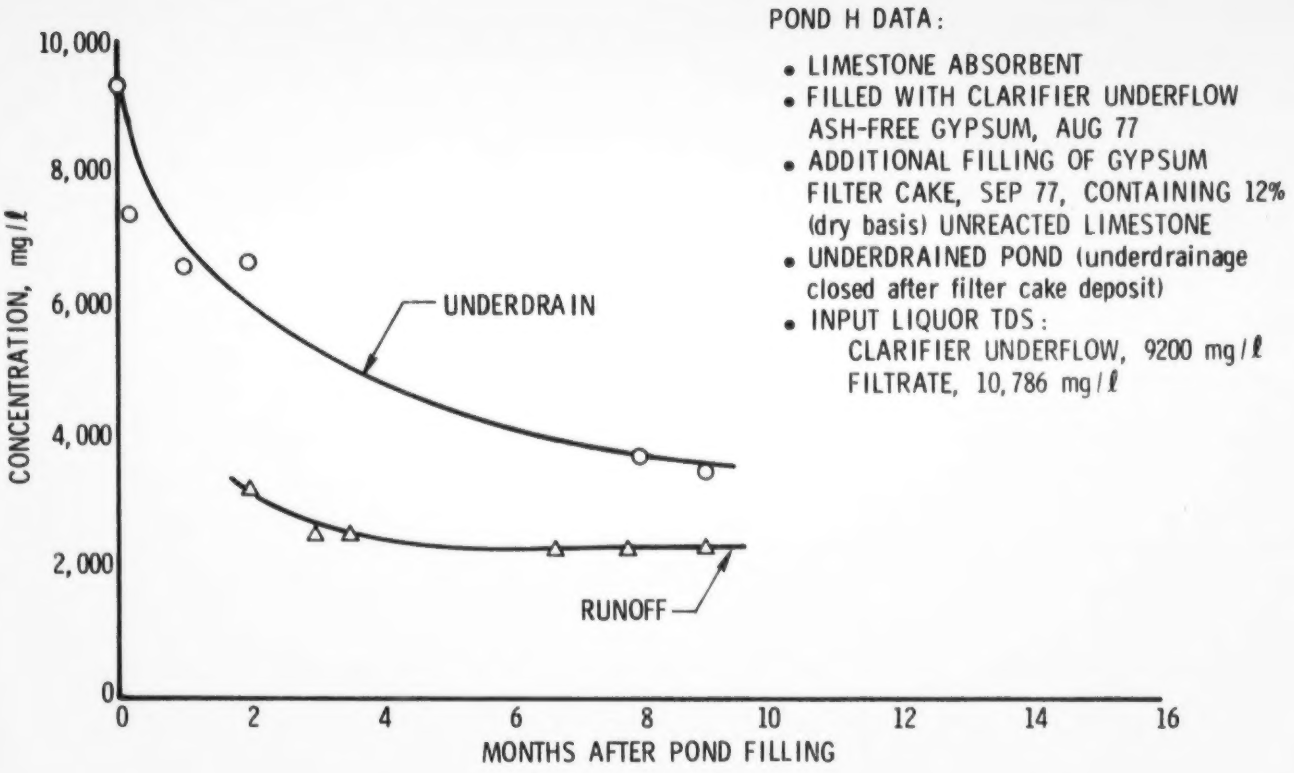

Figure 44. Comparison of TDS concentration in the underdrain water and runoff of Pond H.

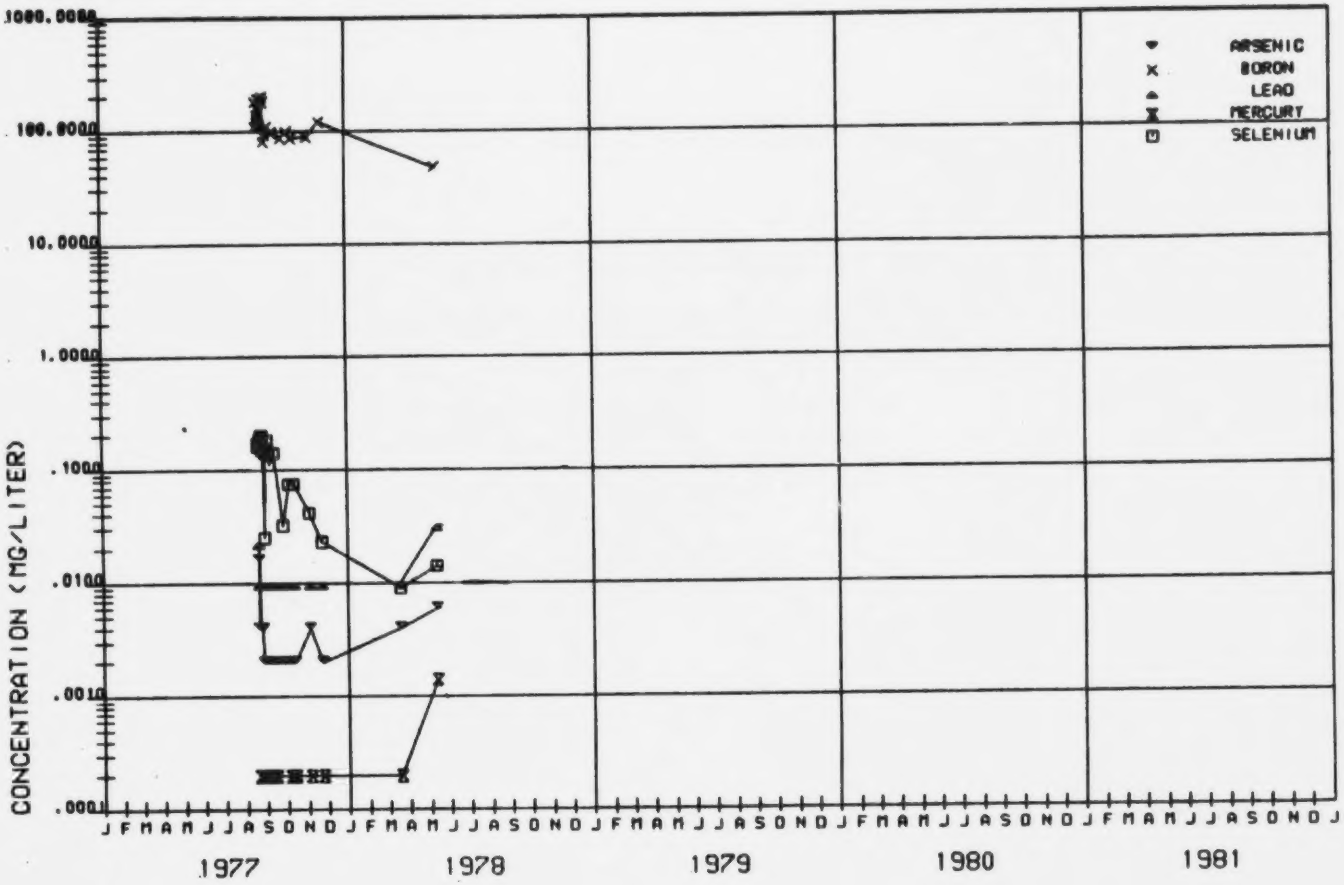

Figure 45. Concentration of minor species in Pond H underdrain.

TABLE 10. SUMMARY OF TYPICAL CONCENTRATIONS OF MAJOR AND MINOR SPECIES IN POND H UNDERDRAIN AND RUNOFF SAMPLES[a]

(Concentrations in mg/ℓ)

	Underdrain	Runoff
Chloride	1300	7-500
Sulfate	1200	1400
Calcium	600	600
TDS	3500	2200
Arsenic	0.006	0.030
Boron	30	0.5 - 27.0
Lead	0.20	0.30
Magnesium	280	5-160
Mercury	0.0012	0.0015
Selenium	0.005	0.0004
Sodium	60	3.0
Potassium	30	3.0
Fluoride	2.0	2.3
TSS	Not measured[b]	4-309

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[a] Sampled in March 1978, six months after placement of the material on the site.

[b] Results from TVA on duplicate samples in this time interval ranged from 130 - 720 mg/ℓ TSS.

Water Retention and Bulk Density

The water retention or, conversely, the dewatering characteristics of FGD wastes are important to the various disposal techniques in that they affect the volume of the disposal basin, the waste handling methods, and the condition of the wastes in their final disposal state. Bulk density is, then, a consequence of the dewatering characteristics of a sludge.

The effectiveness of the dewatering method used and the ability of a sludge to be dewatered are a function of a number of solids characteristics, including the size and distribution of particles, and the crystalline structure of the particles, which are a function of the system, as well as its operating parameters. Data for four dewatering methods are reported: settling, settling by free drainage, vacuum filtration, and centrifugation. The results are based on laboratory experiments.

The highest density is obtained principally by vacuum-assisted filtration in most sludges and by centrifugation in a few cases. In all cases, relatively small density differences result from these two dewatering methods.

In most sludges, there is very little difference in the density when dewatered by settling or by settling combined with free drainage. While free draining may not produce a significant increase in bulk density, the slight gain coupled with the associated higher solids content may in some cases significantly increase load-bearing strength.

Generally, the wet-bulk density ranged from a low of approximately 1.5 g/cm^3 (94 lb/ft^3) for settled sludges to a high of 1.65 g/cm^3 (103 lb/ft^3) for vacuum filtered (Table 11). Drained and centrifuged values were intermediate to these extremes, with drained being slightly higher than the settled and centrifuged slightly lower than filtered. These values were obtained under laboratory conditions and may not necessarily be representative of results obtained from the use of commercial dewatering equipment.

Compressive and Load-Bearing Strength

The structural characteristics of wet FGD sludge affect its use where land reclamation is desired. Unconfined compressive strength of untreated wastes are low, and generally no specific values are reported because the material is usually too soft to measure. However, dewatering can produce improved structural qualities.

Load-bearing strength when plotted as a function of solids content, exhibits a point above which the strength increases rapidly to values well above the minimum for safe access of personnel and equipment. However, the critical concentration appears to be unique for each type of sludge tested. In addition to providing data and load-bearing strengths of lime and limestone sludges (with and without fly ash), Figure 46 illustrates the effect of the absorbent and fly ash on dewatering characteristics. As contrasted to lime,

TABLE 11. BULK DENSITIES OF FGD WASTES

Sample Source and Date	Fly Ash, wt% (dry)	Dewatering Method[a]							
		Settled		Settled and Drained		Centrifuge		Filter	
		Solids, %	Density, g/cc	Solids, %	Density, g/cc	Solids, %	Density, g/cc	Solids, %	Density, g/cc
Shawnee Limestone, 2/1/73	20	49	1.45	56	1.51	60	1.56	65	1.65
Shawnee Limestone, 6/15/74	40	53	1.46	58	1.53	63	1.60	66	1.64
Shawnee Lime, 3/19/74	40	42	1.34	43	1.36	50	1.44	56	1.51
Shawnee Lime, 9/8/76	40	45	1.34	58	1.50	53	1.44	61	1.54
Shawnee Lime, 9/8/76	~ 0	47	1.37	51	1.41	48	1.38	57	1.49

[a] Using laboratory equipment.

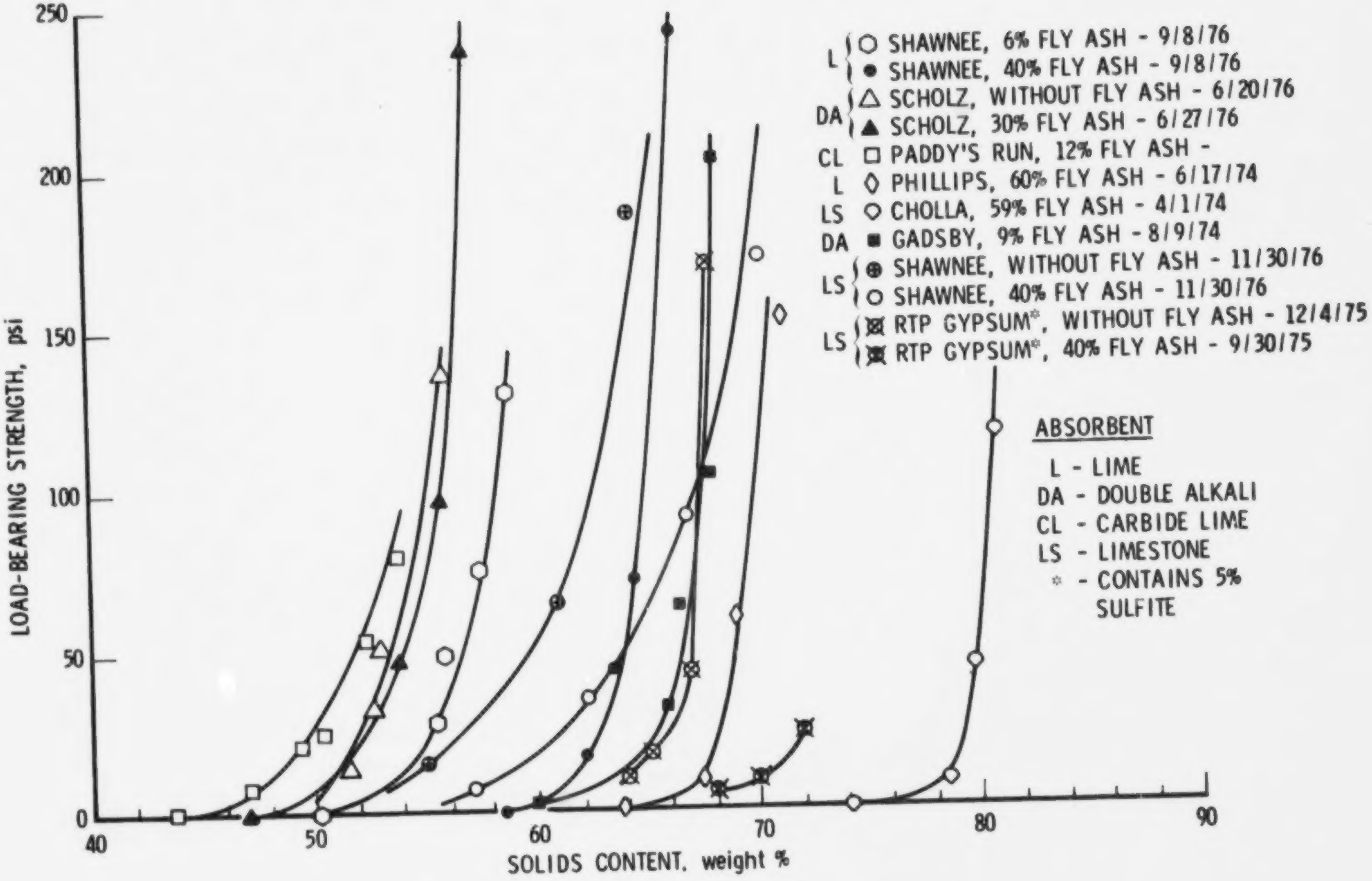


Figure 46. Load-bearing strength as a function of moisture, fly ash content, and sludge origin.

limestone sludges are capable of being dewatered to higher solids contents; however, lime sludges generally attain high bearing strengths at lower solids content than limestone sludges. The presence of fly ash enhances dewatering in both types of sludges. For any specific solids content of a given sludge, the load-bearing strength is less with fly ash than without.

The load-bearing strength of untreated sludges in undrained ponds, such as A and D, has been too low to support personnel (air-drying produced adequate strength in Pond A, but it was lost upon rewetting). In preparation for the filling of Pond G, laboratory tests were conducted on ash-free lime sludge filter cake, remixed with fly ash in a quantity representing 40 wt% of total solids; samples were allowed to settle or drain to obtain bearing-strength measurements as a function of draining time. The test results show that undrained settling alone would not produce bearing strengths above 40 psi after a settling time of 13 days. Samples which were allowed to drain, however, showed significant increases in bearing strength within a short period of time. For example, samples in which half the fly ash was remixed in the sludge and the other half placed in layers showed bearing strengths of greater than 20 psi in 12 hr and greater than 50 psi in 24 hr. The layering configuration was selected for the filling of Pond G, and it was demonstrated during filling that personnel could walk on the surface between 2 and 10 hr after the sludge and fly ash had been placed in the pond. Field evaluations of underdrained ponds of lime and limestone sludges have shown that these materials are capable of supporting light construction equipment within 12 hr after a heavy rain. High bearing capacity in excess of 100 psi were reached (Table 12). However, the need for layering sludge with fly ash may not be necessary; e.g., Pond F, which is not layered and has lower bearing capacity properties than Pond G, is nevertheless capable of supporting personnel and light construction equipment.

Laboratory analyses have indicated that limestone sludges produced at Shawnee typically have load-bearing strengths superior to that of Pond F. Therefore, further study will be conducted on bearing strength as a function of absorbent usage, scrubber operating parameters, resultant crystalline structure, and moisture content after drainage.

Permeability

The pollution potential of sludge liquor seeping into groundwaters is governed by the mobility of leaching waters. This mobility is limited by the coefficient of permeability of the various media through which this leachate must pass.

The permeation rate of leaching waters through the sludge defines an upper limit to the amount of leachate that enters the subsoil. The amount of liquid and the level of contamination of this liquid are jointly responsible for the pollution potential of any given waste disposal site.

The permeability coefficient of untreated wastes containing fly ash is approximately 2×10^{-4} cm/sec (Table 13). The permeability coefficient of untreated sludges has been shown to be a function of the volume fraction of

TABLE 12. SLUDGE ULTIMATE BEARING STRENGTH

Pond and Absorbent	Bearing Capacity, psi[a]		
	Distance Below Sludge Surface		
	1-2 in.	2-4 in.	4-6 in.
Pond B,[b,c] Lime	10-15	150	150-300
Pond C, Limestone[c]	150-330	240-300	330
Pond E, Limestone[c]	75-300	90-300	300-330
Pond F, Limestone	50-75	60-75	60-75
Pond G, Lime	100-150	100-150	180-240
Pond H, Gypsum[d]	330	330	>330
Soil (Shawnee, Clay)	60-100	120	240-300

[a] Data taken in August 1977 within 24 hr following a 3.3-in. rainfall.

[b] Pond B covered by 4 in. of water.

[c] Chemically treated.

[d] Tests for Pond H made on settled and drained clarifier underflow.

TABLE 13. PERMEABILITY OF SHAWNEE SLUDGES[a]

Sludge[b]	Void Fraction	Permeability Coefficient, cm/sec
Lime	0.75	1.8×10^{-4}
Limestone	0.69	2.0×10^{-4}

[a] Reference 4.

[b] All samples contain fly ash (40 wt %) (dry).

TABLE 14. EFFECT OF COMPACTION ON PERMEABILITY OF UNTREATED SLUDGE

Sludge	Void Fraction	Permeability Coefficient, cm/sec
Lime	0.75	1.8×10^{-4}
	0.68	6.0×10^{-5}
	0.60	1.4×10^{-5}
	0.54	7.3×10^{-6}
Limestone	0.69	2.0×10^{-4}
	0.56	6.0×10^{-5}

solids in the waste. These values are intermediate to typical values for silty sand and sandy clay, which are 10^{-4} cm/sec and 5×10^{-6} cm/sec, respectively (Ref. 2).

Consolidation of untreated wastes in a column open at the base, under pressures of 30 to 100 psi, reduced the void fraction and also reduced permeability coefficients by a factor of from 2 to 5 (Table 14). The higher solid volume fraction, resulting from compaction or consolidation, and the resultant decrease in permeability appears to be a function of the size of the sludge particles and the size and distribution of the fly ash particles. Consolidation of untreated sludge at the base of a 40-ft deep disposal site may decrease permeabilities to about 10^{-5} cm/sec as compared with 10^{-4} cm/sec at the surface.

Chemical treatment tends to reduce permeability by less than a factor of 2 in some cases and by several orders of magnitude in others.

Viscosity

The viscosity of the sludge is indicative of its pumpability, which affects both the mode and cost of sludge transport. The results of viscosity tests for various sludges from the Shawnee test facility show that easily pumpable mixtures (less than 20 poise) range from a high solids content of 55 wt% to a low solids content of 40 wt% (Figure 47).

The wastes produced in FGD systems contain finely divided particulate matter suspended in an aqueous medium and consist of three major phases having markedly different morphologies: calcium sulfite hemihydrate, calcium sulfate dihydrate, and fly ash. It is both the particle size distribution and phase morphology that are believed to influence the viscosity of the sludges.

Both calcium sulfate and sulfite scrubber waste products tend to have particle sizes in the same range as fly ash, i.e., between 1 and 100 μm. However, fly ash is formed as spheres, while sulfite wastes are platelets (limestone) or rosettes (lime) and sulfates are blocky in shape. Unreacted $CaCO_3$ from the limestone (or precipitated from the lime process) is usually present in the waste and contributes an additional shape parameter. The data clearly suggest that fly ash decreases the viscosity of a sludge, e.g., the effect of limestone sludge containing 40, 20, and 1% fly ash and lime with 40 and 1% fly ash (Figure 47). It was also observed that the presence of fly ash has a more marked effect on limestone sludge than on lime sludge in reducing viscosity.

8.1.7 Underdrain Design

An analysis of an underdrain design was conducted to determine an understanding of the major components necessary to estimate the system costs. The analysis provided an estimation of seepage rate through the untreated sludge and subsoil for a system vented to the atmosphere, calculation of drain

CURVE	SLUDGE	FLY ASH, %	DATE
1	GM PARMA DOUBLE ALKALI	7.4	7/18/74
2	UPL GADSBY DOUBLE ALKALI	8.6	8/9/74
3	TVA SHAWNEE LIME	40.5	3/19/74
4	DLC PHILLIPS LIME	59.7	6/17/74
5	TVA SHAWNEE LIMESTONE	20.1	2/1/73
6	TVA SHAWNEE LIMESTONE	40.1	6/15/74
7	TVA SHAWNEE LIMESTONE	40.9	7/11/73
8	LG&E PADDY'S RUN CARBIDE LIME	12.4	7/76
9	TVA SHAWNEE LIME	<1.0	9/8/76
10	TVA SHAWNEE LIMESTONE	<1.0	9/28/76
11	GPC SCHOLZ SODA ASH DOUBLE ALKALI	<1.0	6/20/76
12	GPS SCHOLZ SODA ASH DOUBLE ALKALI	30.0	6/27/76
13	TVA SHAWNEE LIME	40.0	9/8/76

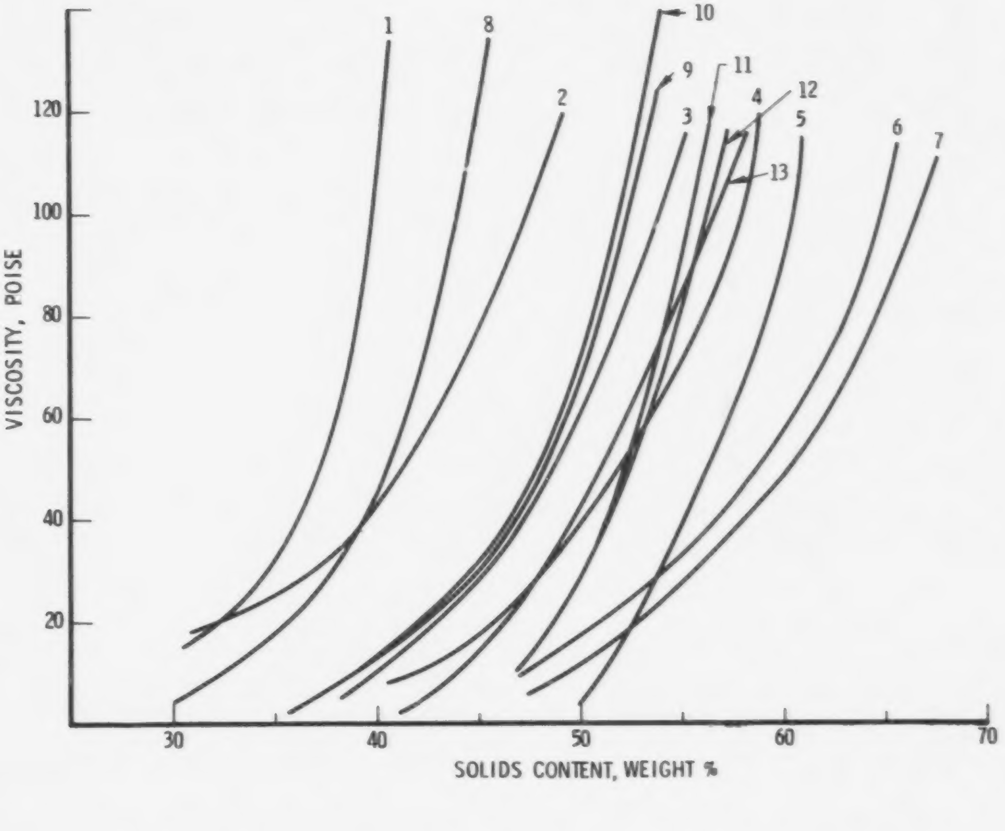


Figure 47. Viscosity of Shawnee FGD sludges.

pipe spacing for horizontal and sloped pond bottoms, and an evaluation of five alternative perforated-pipe and sand-layer designs.

The estimation of seepage rates through sludge layers in waste disposal ponds and into the subsoil utilized a simplified relationship neglecting evaporation, capillary effects, and interference with the natural water table. The analysis assumed a quasi-steady flow through a saturated medium at rates governed by Darcy's law.

Characteristic drain times and seepage rates were estimated for sludge layer thickness in a 6-ft deep model (Pond F) and a full-scale, 30-ft deep pond. Sludge drainage rates are in the vicinity of 1.5×10^{-4} cm/sec. In order to prevent the buildup of rainfall and input liquor within and on top of the sludge layer, the design rate of seepage removal at the bottom of the pond must exceed the rate at which water is introduced. Based on an average rainfall rate of 4.3×10^{-6} cm/sec (2.54 cm/wk) and scrubber output on the pond of 4.9×10^{-5} cm/sec (1600 gpm) water, the seepage is about three times the input rate. Even during heavy rain storms (say, 20 cm/wk), when underdrain is provided, water would not accumulate on top of the sludge. If such a condition were to exist whereby the scrubber could not accept the total seepage, water would merely be allowed to accumulate and then drawn down in the future as allowed by the scrubber.

Seepage into the subsoil was estimated assuming various hydrostatic pressure heads at the pond and subsoil interface and no interference with the natural water table. If, for example, the subsoil coefficient of permeability were 10^{-6} cm/sec, the penetration with underdrainage would be 14 in./yr in the vicinity of the trenches holding the drainage pipes, which may be approximately 10 × 10 in. and as much as 100 ft apart or greater; penetration of the soil between the drain trenches would be negligible because the water would be only a film on the base of the pond. By comparison, the subsoil seepage from a similar pond without underdrains would be about 6 ft/yr from the entire pond bottom. Considering the depth of seepage and the pond base area contributing to the seepage, the underdrained pond would release about 0.16% as much water as the nondrained pond. Additionally, the underdrained pond would be closed, capped, and reclaimed after about 2 years, thereby preventing future seepage.

The use of varying soil permeability was considered. For example, a soil coefficient of permeability of about 10^{-7} cm/sec, which is considered highly impermeable, would constitute a pond lining. The value of underdrainage with a pond soil such as that is that the underdrainage would dewater the sludge to a point at which it would be structurally sound. If the soil k were 10^{-5}, indicating a highly porous soil, the seepage at the drain trenches would be about 12 ft in one year, at which time the pond could be closed and capped.

The second analysis considered the maximum spacing between drains for several cases. Dupuit/Forchheimer and Boussinesq assumptions (Refs. 11 through 14) were used with Darcy's Law to create a seepage model with replenishment, which was used to derive drain spacing relationships with various layer depths to be installed beneath a disposal pond. The height of the water-void boundary surface in the sand as a function of the horizontal coordinate was obtained for both level and slightly inclined beds by expanding the solutions as a perturbation series in powers of the bed slope. For example, using a one-foot thick sand layer and following the requirement that the theoretical water level in the drains be zero, the maximum spacing between drains in a horizontal base was found to be 133 ft, while in a base inclined at a 1% slope, the maximum spacing is increased to 240 ft.

The five alternative perforated-pipe and sand-layer designs were used in combination with price lists for materials and labor to select the final cost-minimizing design. A summary of optimum design characteristics (assuming no safety factor) for three sand-layer thickness, 3.5, 2.0 and 1.0 ft, are shown in Table 15. For the last two thicknesses, sand layers with horizontal beds and with beds alternately sloped at 1% toward the field drains were examined as subcases, whereas the 3.5-ft case was examined for the sloped condition only.

Inclining the base at 1% toward the drains reduces the number (and liner feet) of drainpipes required by a factor of about 2, because it increases the allowable spacing between drains. It also doubles the discharge that must be carried by the drain, but the pipe diameter needed for the horizontal sand layer designs is also large enough to carry the increased discharge from the sloped layers.

In a comparison of the various designs, the costs of grading the sand-layer bed, trenching, and gravel were also considered. For example, it might appear that, because Design IIb required only 2400 ft of 6-in. pipe while IIa requires 4800 ft, the former is the more economical design. However, Design IIb calls for accurately grading the sand-layer bed to alternating slopes every 300 ft, while IIa requires only that the bed be graded horizontally. The incremental cost of specialized grading may offset the cost of an additional 2400 ft of perforated pipe.

A water balance of an underdrained disposal pond is presented in detail in a companion report (Ref. 4), which describes the portion of the Aerospace effort concerned with sludge characterization and assessments of disposal alternatives. In the underdrain system, all rainfall on the disposal pond, except that which evaporates, becomes part of the scrubber water loop, which effectively reduces the normal amount of fresh makeup water. The net effect on the water balance is to increase the concentration of chloride in the scrubber loop.

The amount of chloride increase can depend on the pond size, amount of evaporation and rainfall, degree of settling of the sludge material, and amount of chlorine in the coal and can be limited by the rate of return of the pond underdrain water to the scrubber. These factors will be considered in more detail in the final Shawnee Report. Preliminary analysis has shown, however, that if ponds are constructed so that the working section is the size required to accommodate roughly a 2-year supply (50 acres) of oxidized sludge

TABLE 15. SUMMARY OF OPTIMUM DESIGNS FOR DIFFERENT SAND LAYERS

Design	I[b]	IIa	IIb	IIIa	IIIb
Sand-layer thickness, ft	3.5	2.0	2.0	1.0	1.0
Bed slope, %	1.0	0	1.0	0	1.0
No. of drains	--	4	2	9	5
Drain spacing, ft	--	300.	600.	133.	240.
Drain discharge, ft^3/sec	--	0.059	0.118	0.026	0.047
Diameter of drain d, in.	--	6	6	4	4
Slope of drain, %	--	0.5	0.5	0.5	0.5
Total length required, ft	--	4800.	2400.	10,800.	6000.
Header discharge, ft^3/sec		0.236	0.236	0.236	0.236
Diameter of header, in.	8.	8.	8.	8.	8.
Slope of header, %	0.5	0.5	0.5	0.5	0.5
Total length of header, ft	2400.	2100.	1800.	2300.	2160.
Volume of sand, ft^3	5.0×10^6	2.9×10^6	2.9×10^6	1.4×10^6	1.4×10^6

[a] Assumed Values:
$q = 10^{-5}$ cm/sec (replenishment rate)
$k = 0.1$ cm/sec (sand conductivity)
$M = 0.02$ sec/$ft^{1/3}$ (friction factor)
$t = 4$ in. (thickness allowance for sludge infilt. into sand layer)

[b] In Case 1, drain pipe and header are the same.

from a 1000-MWe station, the chloride concentration, being 5000 mg/ℓ without underdrainage, would go steady state at about 8400 mg/ℓ. (For simplicity, it was conservatively assumed that all chloride in the scrubber loop, including the pond, is in solution.) This steady-state condition would remain throughout the life of the first pond. New ponds would then be added to thesystem. Each pond would be closed in succession to disallow further infiltration of rainwater into the scrubber loop.

A temporary increase in chloride concentration can be expected after each pond transfer because of the partial replacement of makeup water with drainage water from the previous pond. The amount will depend upon the degree of settling and flow of the drainage. For example, a settling of from 74% solids to 80% solids (such as observed in Pond H after clarifier underflow filling) over 0.2 years would yield a temporary concentration of chloride of about 14,700 mg/ℓ. However, this concentration would decrease to a new steady-state concentration slightly in excess of 9000 mg/ℓ for each new pond. After about six transfers, a new overall steady-state concentration of chloride would be reached at 9100 mg/ℓ of chloride. A short survey of scrubber suppliers has not revealed a design upper limit for chloride because the scrubbers are now all protected against corrosion. Calcium sulfate concentrations (the major constituent of TDS) are in chemical equilibrium in the scrubber/disposal pond system. An increase of chloride does not appear to significantly alter the sulfate balance.

8.2 TREATED SLUDGE

Three ponds are being evaluated at Shawnee which have been filled with chemically treated material. Pond B was filled in April 1975 with clarifier underflow (limestone absorbent), treated by the Dravo Corporation. Pond C was also filled in April 1975, with centrifuge cake (lime absorbent), treated by IU Conversion Systems, Inc. Pond E was filled in December 1974 (limestone absorbent), with clarifier underflow treated by Chemfix, Inc. The filling operations and treatment details are described in Ref. 1, and the results of the analyses of the input liquor to those ponds is shown in Table 9. The configuration of Pond E was changed in November 1977 when the supernate was drained from the pond and the pond was filled with soil, compacted, and graded (Section 7.4). The leachate well at Pond E, which was drained at the time of pond closure, has been monitored since that time whenever a small quantity of seepage occurred.

8.2.1 Pond B Water Analyses

The two groundwater wells associated with Pond B have been monitored over a 3-year period and show no unusual trends or concentrations. The TDS concentration has varied slightly but has remained essentially constant in a range of between 450 and 550 mg/ℓ (Figure 48). The chloride, sulfate, and calcium concentrations have also been relatively constant, except that chloride has shown a slight decrease and one sulfate reading was higher than usual. The six minor species have likewise remained relatively constant over the 3-year period. Therefore, it appears that there has been no effect on the

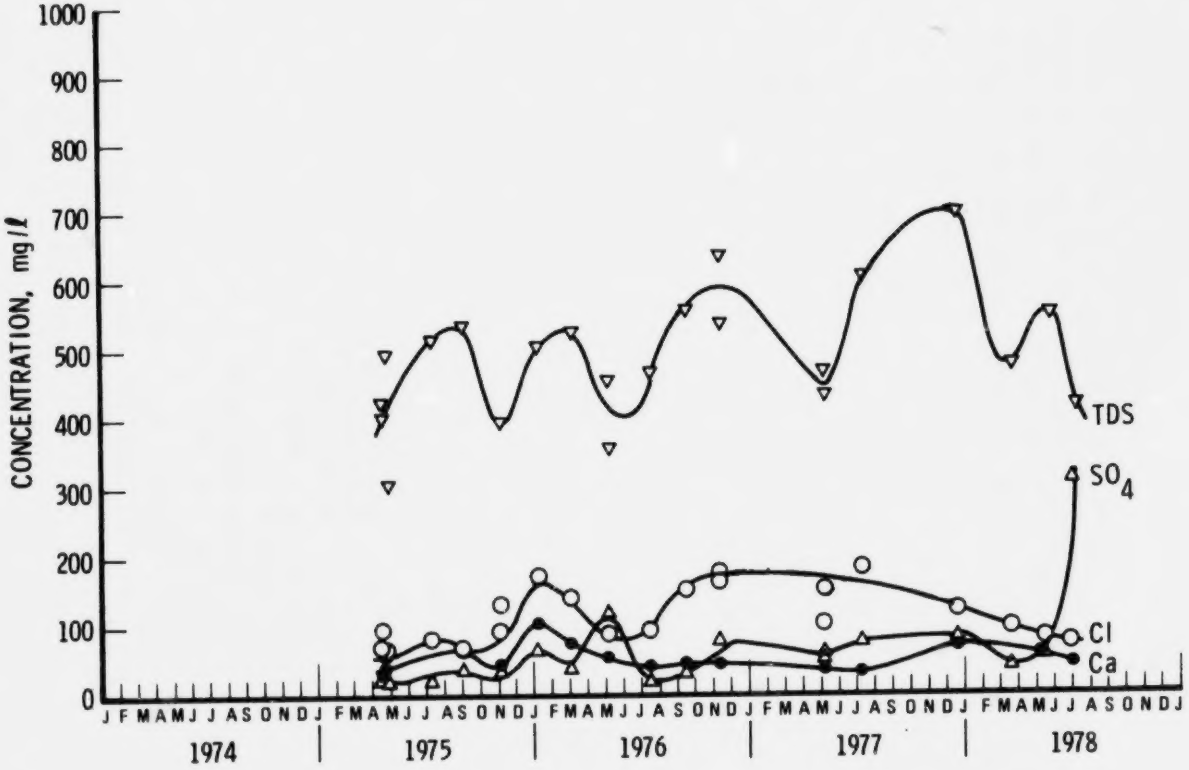


Figure 48. Concentration of TDS and major species in Pond B groundwater.

groundwater from the waters in Pond B, as expected, because of the impermeability of the soil.

Immediately after pond filling, the supernate in Pond B had a TDS concentration equivalent to that of the input liquor, after which the TDS concentration dropped sharply. Over the 3-year monitoring period, the TDS level and the concentrations of associated dissolved constituents have fluctuated as the quantity of supernate increased or decreased as a result of weather (Figure 49). Sulfate is the major dissolved constituent, followed by calcium. Chloride has been virtually depleted in the supernate since approximately one year after pond filling.

A plot of Pond B leachate and supernate concentration with precipitation as a function of time is given in Figure 50. As described in Section 8.1.2 for Pond D, it is assumed that the leachate concentrations are not affected by supernate concentrations, but with one exception: As shown in Figure 50, the supernate and leachate concentrations converged to an equal value in May 1976. It is believed that because of a coring accident during which a large pit was excavated in the vicinity of the leachate well, a breakthrough in the sludge occurred and allowed a direct flow of supernate to the leachate well. As a result, a new leachate well was installed at the opposite end of the pond, and, as shown in Figure 50, the leachate concentration returned to the level that existed prior to the breakthrough. It is assumed that the rupture repaired itself because later in 1975 the leachate concentrations in the original well decreased to about the same level as before the rupture.

The TDS concentration in the leachate of Pond B has been relatively constant at about 2800 mg/ℓ during the 3 years the pond has been evaluated (Figure 51). The concentration of the six minor species monitored in the leachate have not shown significant changes throughout the 3-year period (Figure 52).

8.2.2 Pond C Water Analyses

The groundwater wells monitored at Pond C have shown results typical of the other groundwater wells at the site. Except for a brief period in 1975, the level of TDS has remained close to 400 mg/ℓ, and the major dissolved constituents have likewise shown no unusual trends or concentrations (Figure 53). The six minor species being monitored also showed no unusual concentrations. Therefore, it appears that the sludge in Pond C has had no effect on the groundwater.

The supernate in Pond C shows a typical weather-induced fluctuation in the TDS concentration and major constituents (Figure 54). The TDS level reached a peak of approximately 4500 mg/ℓ (one-half the concentration of the input liquor) one year after pond filling. Since that time the concentrations of the repetitive peaks have gradually decreased. Chloride has been virtually depleted since May 1977 (2 years after pond filling), leaving sulfate and calcium as the major dissolved constituents.

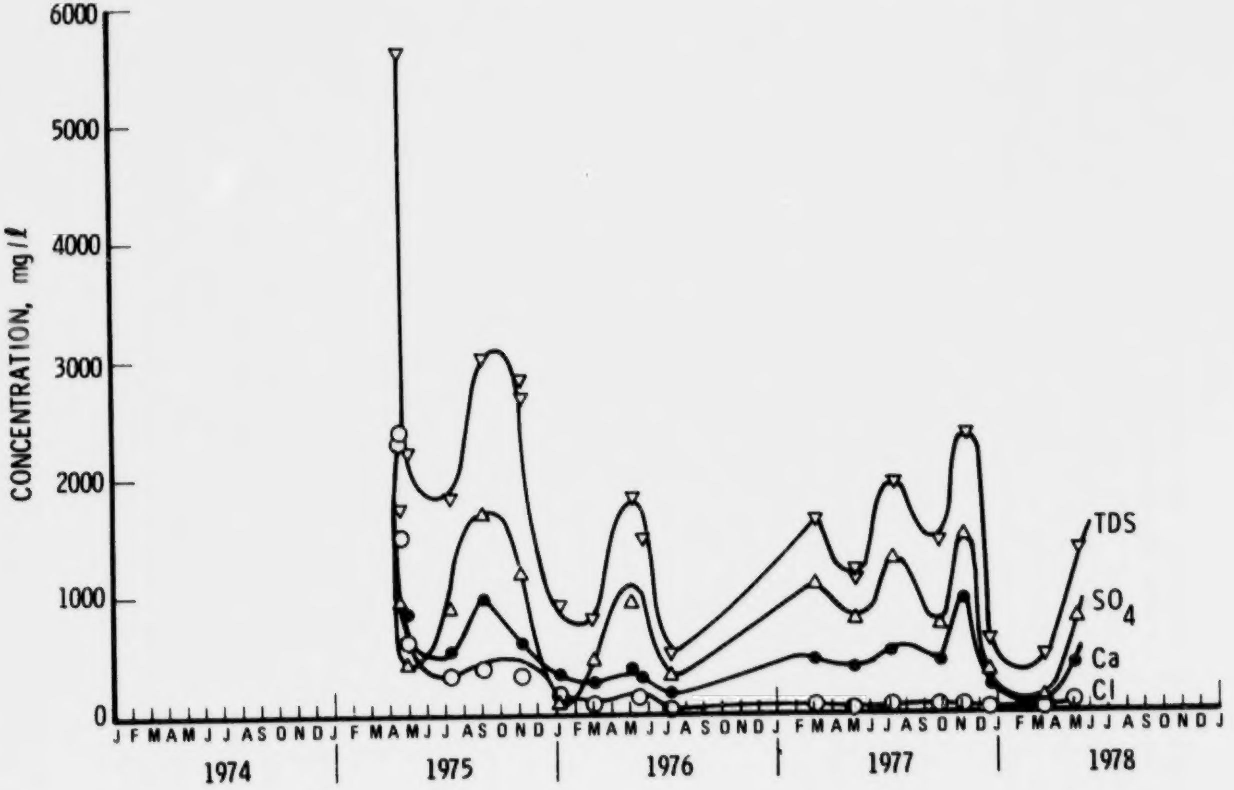


Figure 49. Concentration of TDS and major species in Pond B supernate.

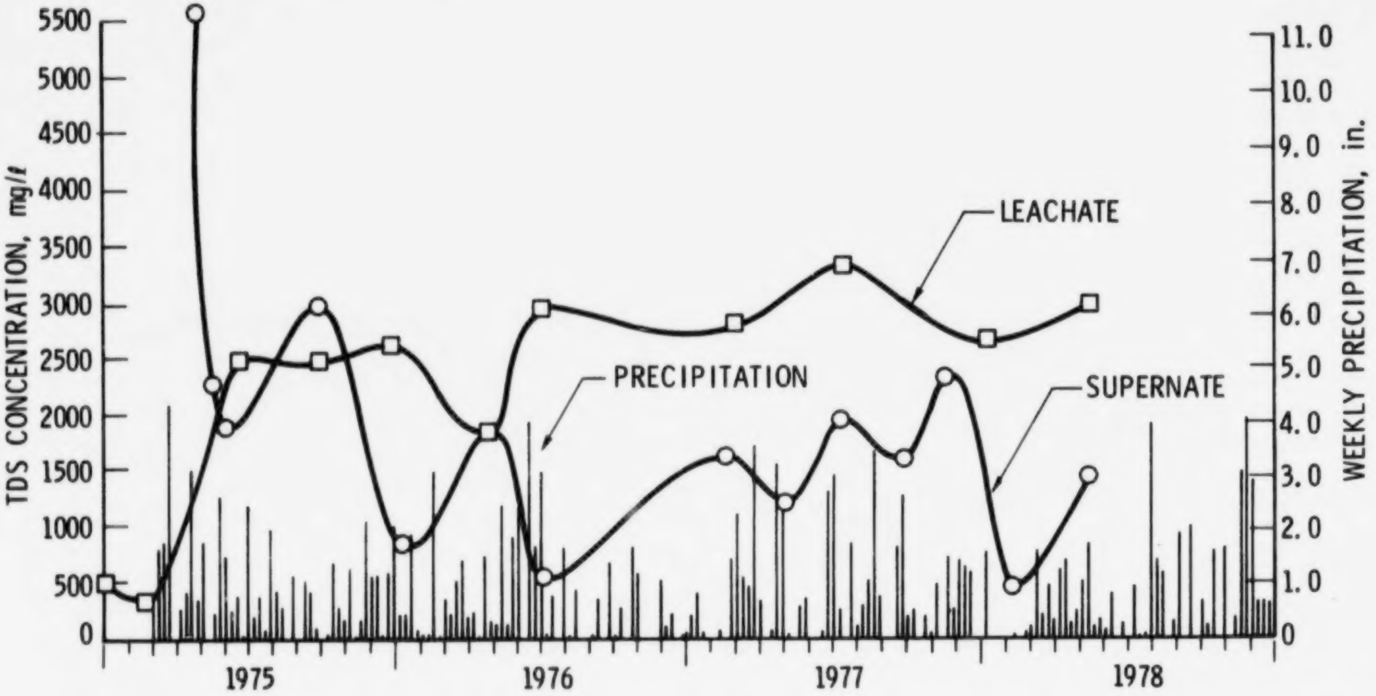


Figure 50. Concentration of TDS in Pond B leachate and supernate with rainfall.

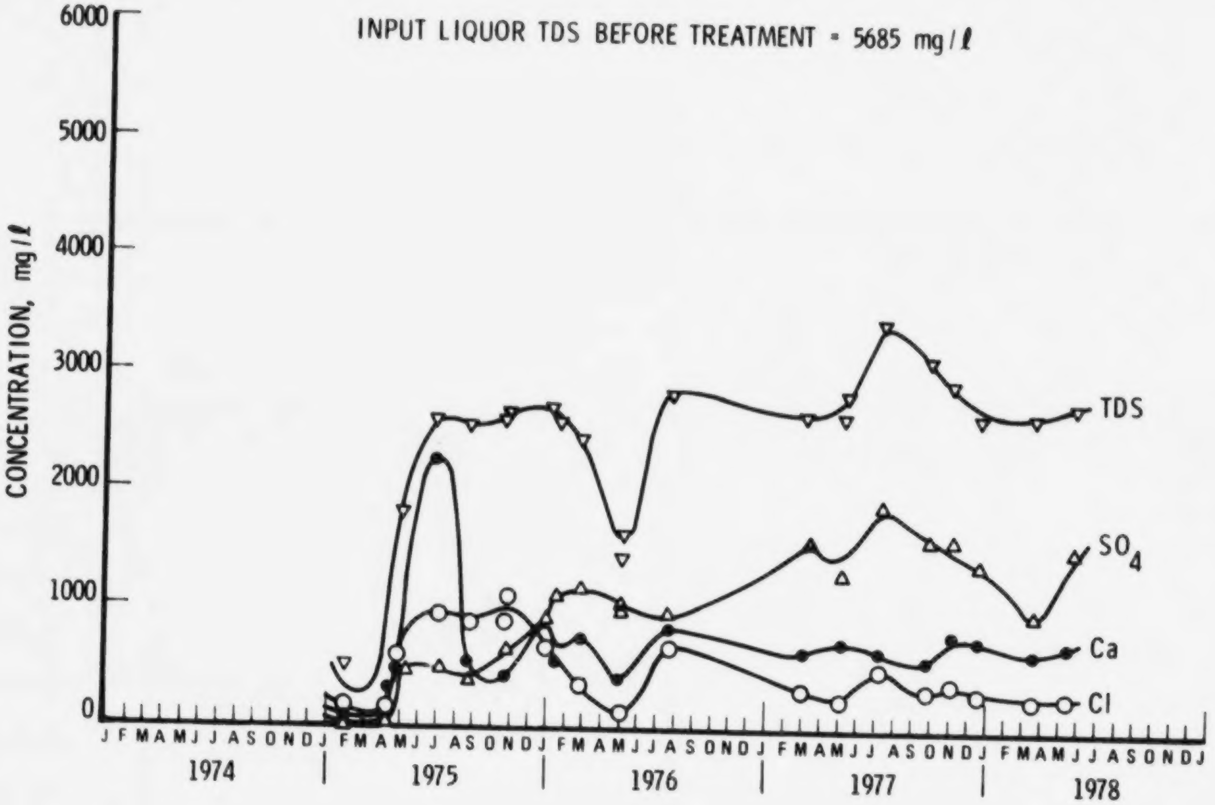


Figure 51. Concentration of TDS and major species in Pond B leachate.

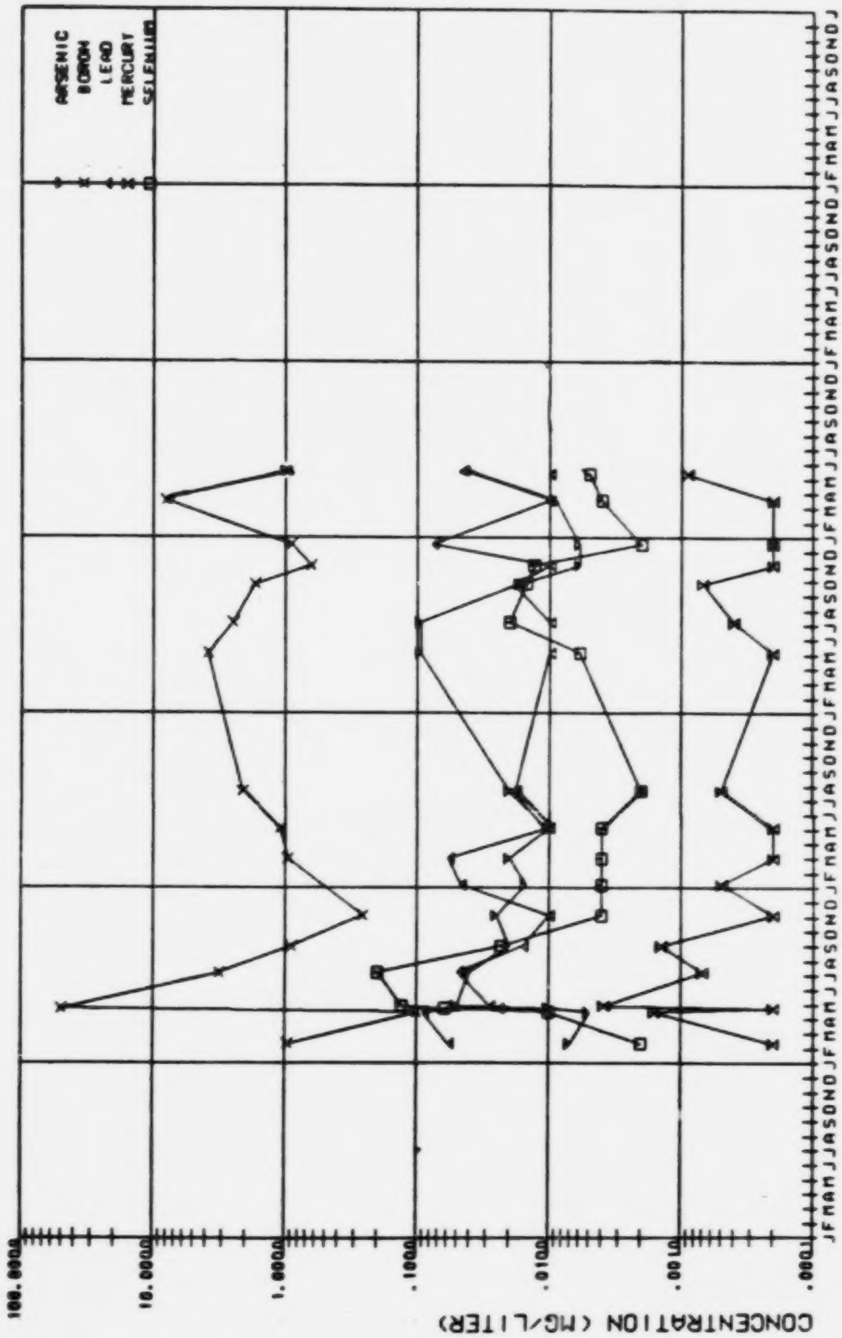


Figure 52. Concentration of minor species in Pond B leachate.

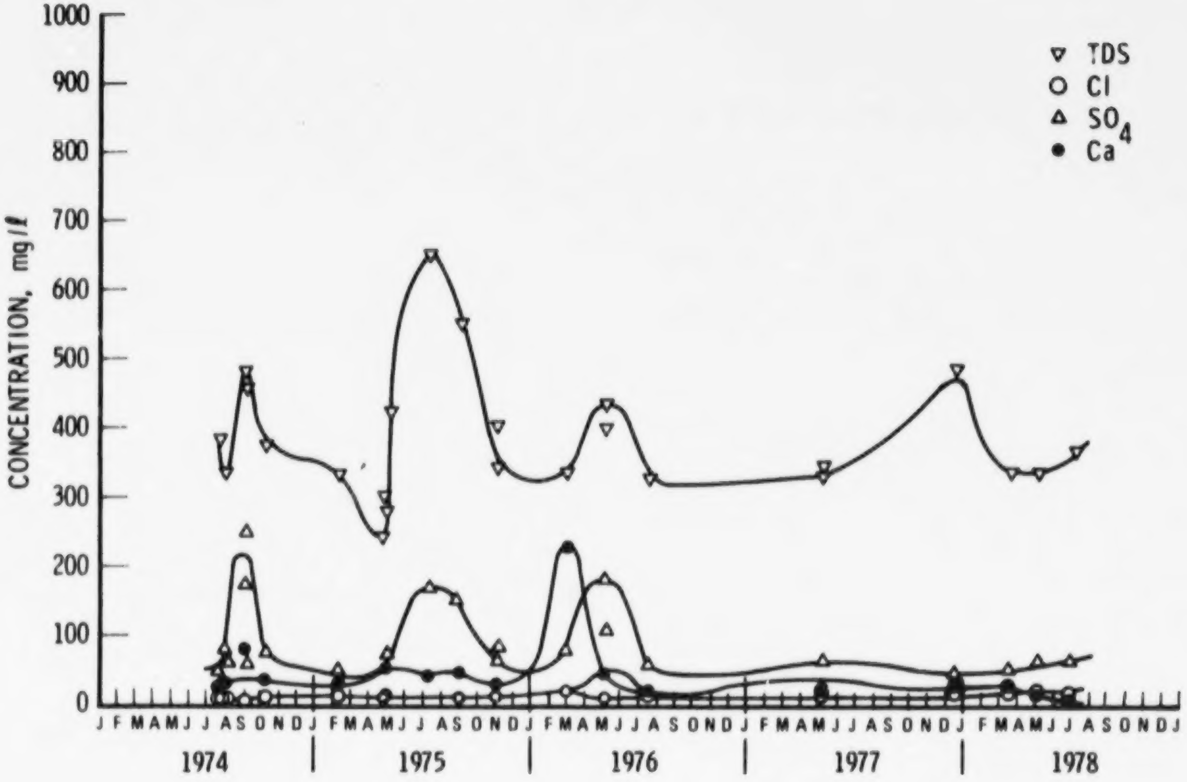


Figure 53. Concentration of TDS and major species in Pond C groundwater.

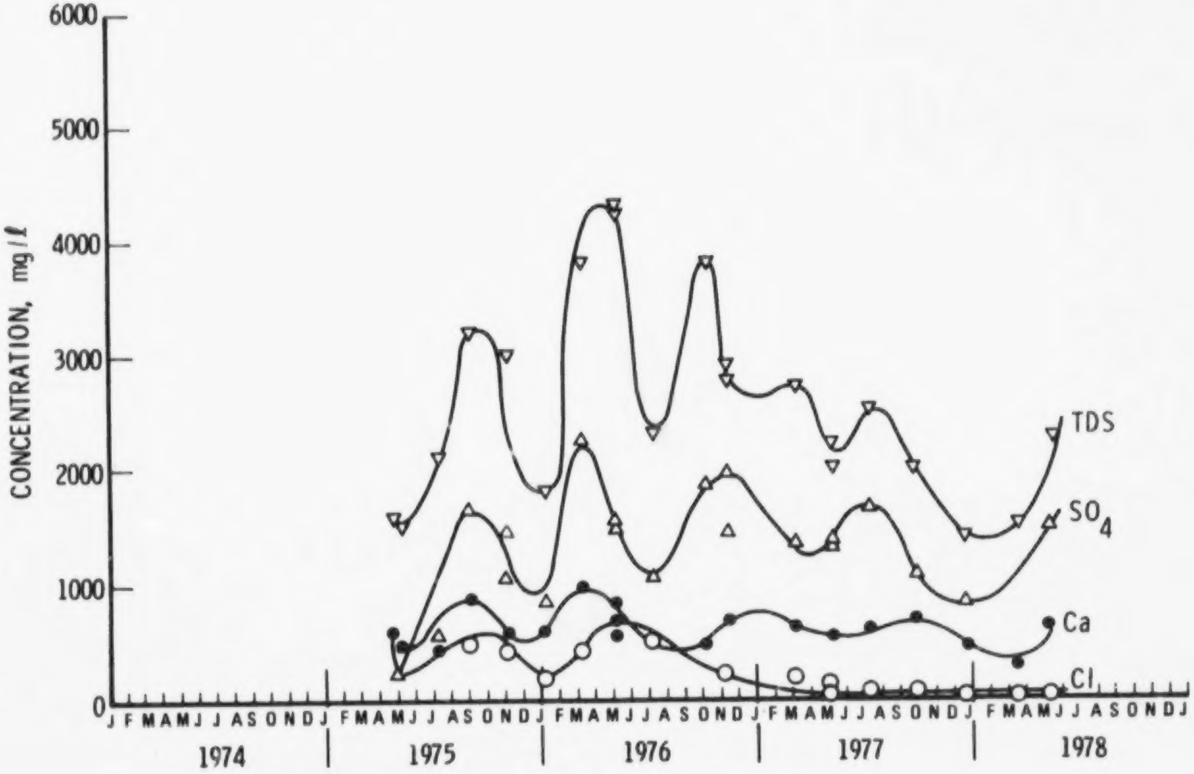


Figure 54. Concentration of TDS and major species in Pond C supernate.

The TDS concentration in the leachate of Pond C reached a maximum shortly after pond filling in April 1975 of 4700 mg/ℓ (approximately one-half that of the input liquor). Since that time the TDS concentration has gradually decreased until, in mid-1978, it had dropped to 2500 mg/ℓ (Figure 55). Chloride is very nearly depleted, and sulfate and calcium are at levels of 1500 and 800 mg/ℓ, respectively. Of the six minor species monitored, arsenic lead, magnesium, mercury, and selenium have all remained at essentially constant concentrations, whereas boron has shown a slight decreasing trend during the last six months of the monitoring period (Figure 56).

8.2.3. Pond E Water Analyses

Monitoring of the groundwater wells for Pond E began in August 1974, some 4 months prior to pond filling. The results through June 1978 show that the TDS concentration and the concentrations of dissolved constituents have remained at constant levels throughout (Figure 57). The six minor species show no unusual concentrations or trends. It can be concluded, therefore, that the sludge in Pond E has had no discernible effect on the groundwater.

The supernate on Pond E was sampled and analyzed starting several months after pond filling in February 1975 and continuing until the pond was closed in November 1977. During that time the TDS concentration, and the concentrations of the dissolved constituents, varied with weather, as is typical of supernate (Figure 58). The peak levels reached by the TDS concentration during that time was approximately 2600 mg/ℓ, or about 40% of the TDS concentration in the input liquor. When the pond was closed, the TDS concentration had dropped to approximately 1200 mg/ℓ, and the chloride was virtually depleted. The six minor species in the supernate did not show unusual concentrations or trends during that time.

The leachate in Pond E exhibited a rapid increase in the TDS concentration after pond filling reaching a peak of 3400 mg/ℓ, or about half the TDS concentration in the input liquor (Figure 59). The TDS level fluctuated after that time and at the time of pond closure in November 1977 remained at approximately 3100 mg/ℓ. There has been very little seepage since the pond was closed, but on a sample taken in March 1978 the TDS concentration was 3800 mg/ℓ. The sodium content in the leachate has been monitored since the pond was filled (since sodium was used in the chemical treatment process), and the sodium concentration has steadily decreased since April 1975, from a level of 1000 mg/ℓ to less than 100 mg/ℓ when the pond was closed in 1977 (Figure 59). The six minor species in the leachate stayed at essentially constant concentrations through the 3-year period the pond was in operation (Figure 60).

8.3 TREATED SLUDGE CORE ANALYSES

During this reporting period two sets of core samples were obtained from each of the three ponds containing chemically treated sludge. The samples were subjected to laboratory tests to investigate both the physical and chemical characteristics of their respective leachates. The methods used to

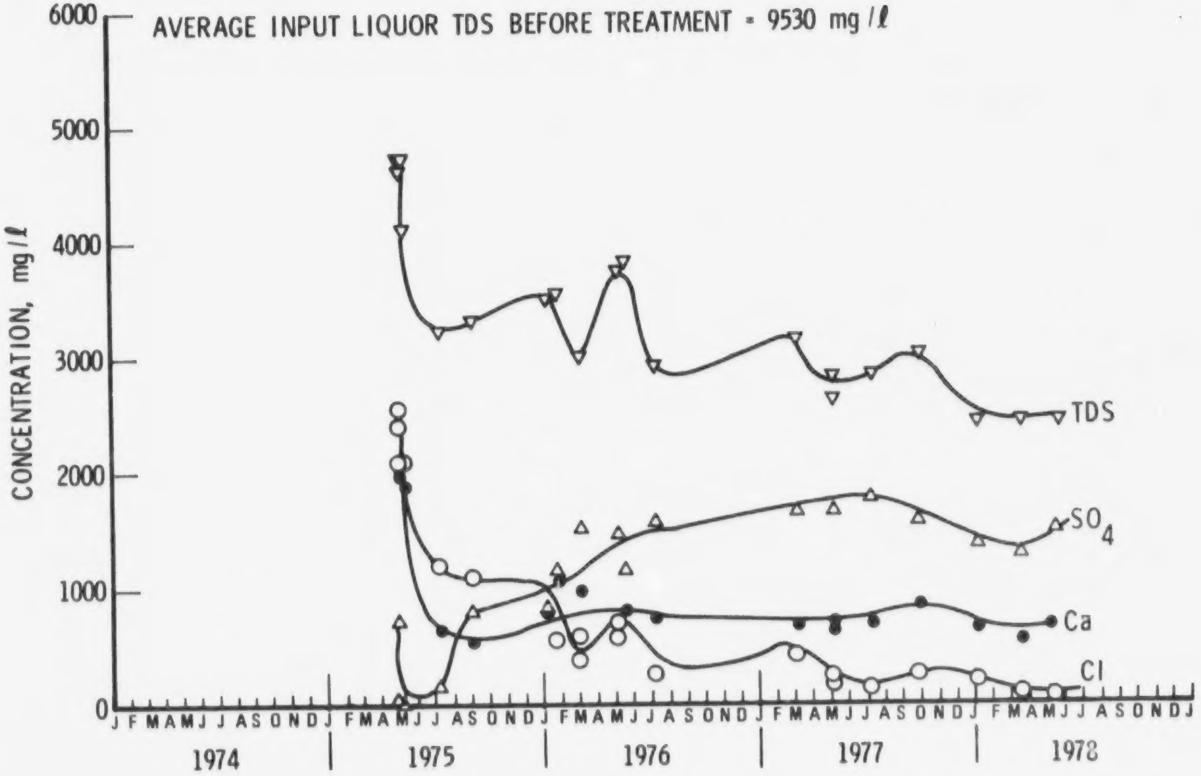


Figure 55. Concentration of TDS and major species in Pond C leachate.

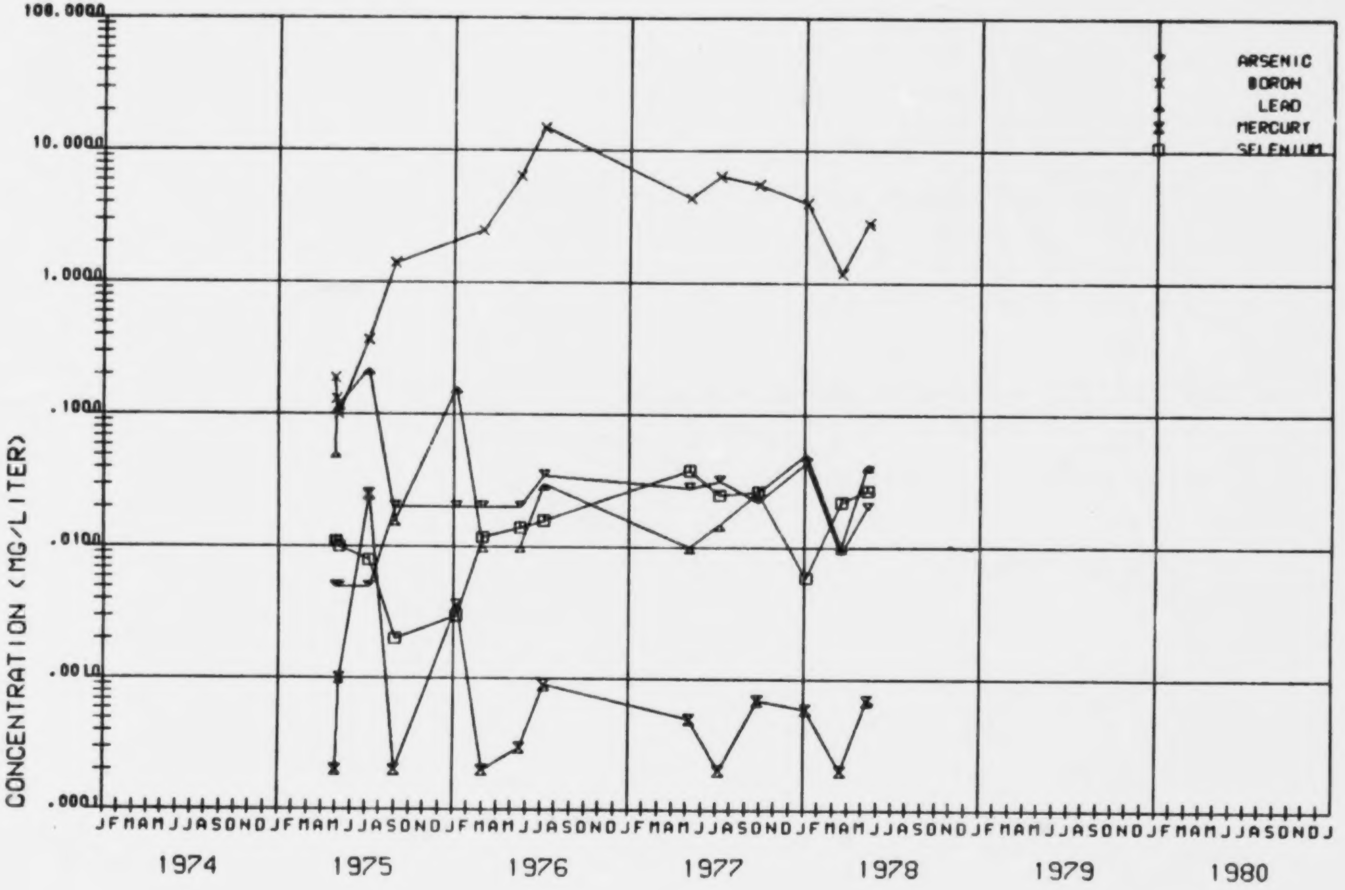


Figure 56. Concentration of minor species in Pond C leachate.

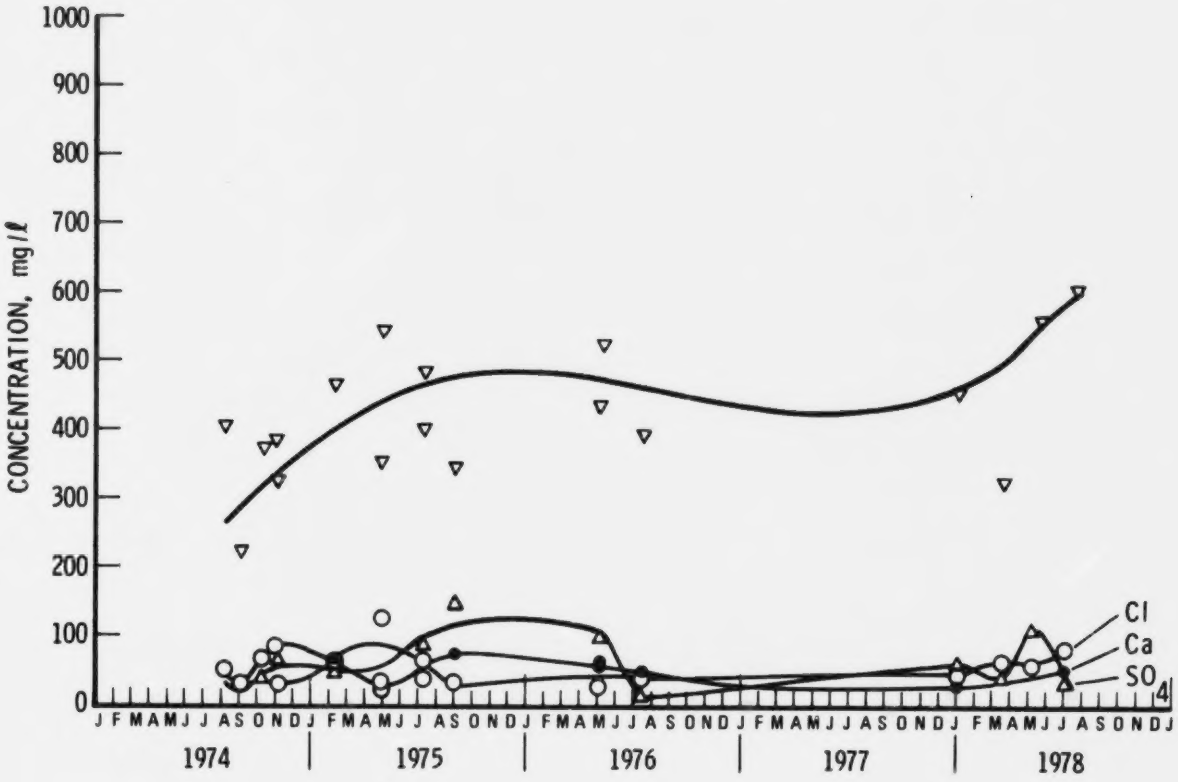


Figure 57. Concentration of TDS and major species in Pond E groundwater.

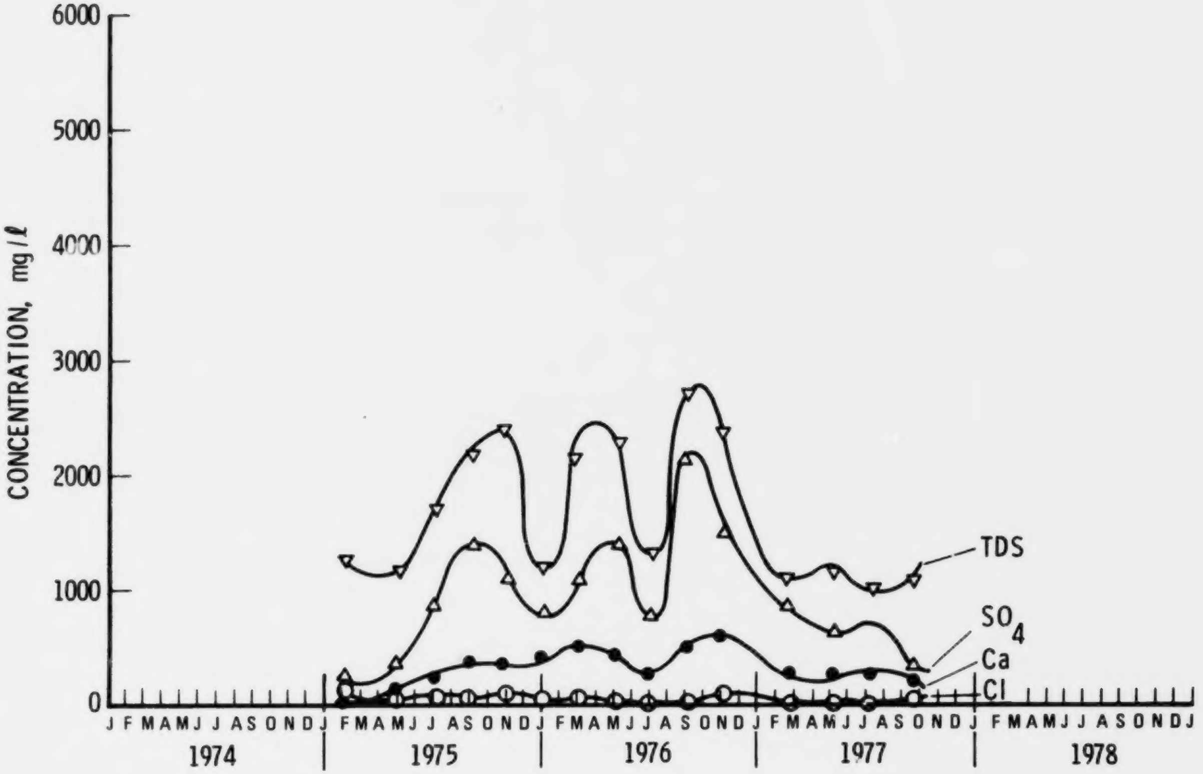


Figure 58. Concentration of TDS and major species in Pond E supernate.

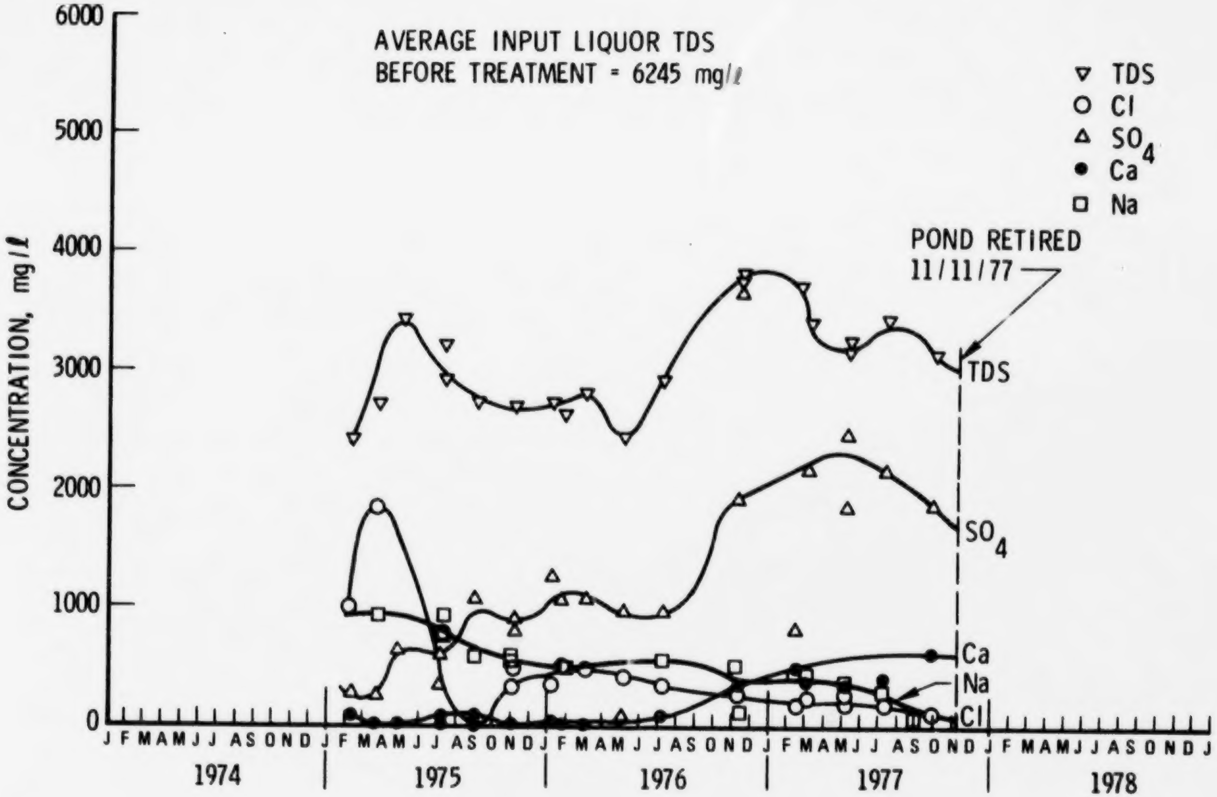


Figure 59. Concentration of TDS and major species in Pond E leachate.

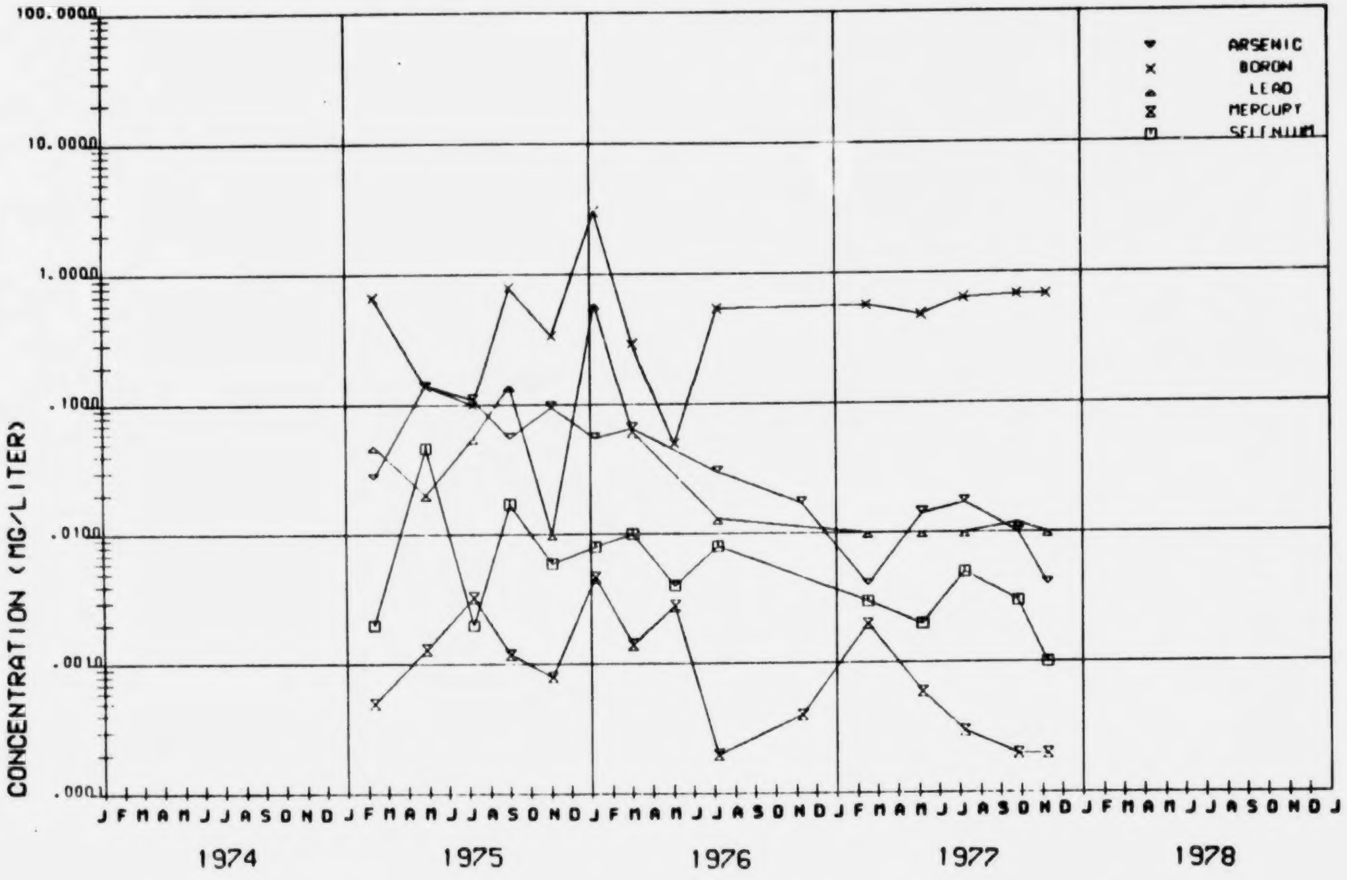


Figure 60. Concentration of minor species in Pond E leachate.

conduct these tests are described in Appendix B. The results of the measurements made on these samples are discussed in the following paragraphs.

Tests were conducted to determine the permeability, moisture content, wet and dry density, and unconfined compressive strength of the core samples obtained from Ponds B, C, and E. Permeability coefficients determined recently ranged from 3.7×10^{-5} cm/sec for Pond B, to 2.9×10^{-5} cm/sec for Pond C, and 5.6×10^{-5} cm/sec for Pond E although extremes of 2.1×10^{-4} and 3.2×10^{-7} cm/sec were recorded in previous years (see Table 16). The recent values were within the range of results obtained previously for these ponds, thereby indicating no apparent time-dependent trends in the permeability coefficient of these chemically treated sludges. It should be noted that the laboratory permeability tests are conducted in selected samples which are chosen to be as crack-free as possible in order to maintain consistency and continuity in the test results. However, in the field the sludge contained in a multi-acre pond will be subject to the effects of heavy equipment operations and other factors, which could cause cracks and voids to form, thereby reducing the impermeability of these materials. The actual reduction realized, of course, is a function of the specific conditions at a particular site.

Typical solids content for the cored materials from the three ponds tested were 44% for Pond B, 63% for Pond C, and 50% for Pond E.

Bulk densities in the as-sampled wet condition for Ponds B, C, and E were approximately 1.37, 1.52, and 1.37 g/cc, respectively. For Ponds B, C, and E, dry bulk densities were 0.63, 0.94, and 0.68 g/cc, respectively.

As shown in Table 16, the results of tests for unconfined compressive strength of samples taken from treated sludges are as follows: Pond B showed values between 10 and 84 psi; Pond C, between 90 and 996 psi; and Pond E, between 24 and 260 psi. Results of in-situ tests of ultimate bearing capacity made in August 1977 with a field-type penetrometer are shown in Table 12. The low bearing capacity results on the top layer of Pond B were very likely caused by freeze-thaw effects because the surface of the pond was without supernate from the first week of November 1976 through the last week of February 1977, and weather data recorded during those months show 74 freeze-thaw cycles during a period of 120 days, or 62% of the total days. A contributing factor to the effects of freeze-thaw cycling on Pond B sludge is its relatively low solids content, 44%, which is the lowest of the three chemically treated materials.

The results of other physical characterization testing conducted on chemically treated sludges since 1975 are summarized in Table 16.

8.4 SOIL ANALYSES

To determine a profile of seepage in the soil below the sludge layer, chemical analyses were conducted on soil samples at 1, 3, and 9 in. below the sludge in each of three ponds (D, C, and E) and at equivalent depths

TABLE 16. PHYSICAL CHARACTERISTICS OF IMPOUNDED TREATED SLUDGE CORES

Pond	Coring Date	Solids Content, wt %	Density, g/cm^3 (wet)	Unconfined Compressive Strength, lb/in^2 (wet)	Density g/cm^3 (dry)	Porosity void fraction (volumetric)	Permeability Coefficient, cm/sec
B	5/29/75	51	1.43	62	0.73	0.71	--
B	6/12/75	42	1.40	30	0.61	0.76	6.9×10^{-5}
B	7/30/75	44	1.30	28	0.56	0.77	1.4×10^{-4}
B	1/14/76	46	1.37	84	0.63	0.75	3.8×10^{-5}
B	7/7/76	44	--	35	--	--	2.1×10^{-4}
B	3/15/77	44	1.36	10	0.63	--	--
B	9/28/77	45	1.35	29	0.61	--	3.7×10^{-5}
C	5/29/75	63	1.69	462	1.07	0.58	5.5×10^{-5}
C	6/12/75	59	1.42	321	0.80	0.68	5.5×10^{-7}
C	1/14/76	61	1.50	40	0.91	0.64	3.2×10^{-7}
C	7/7/76	62	1.50	225	0.93	--	5.2×10^{-5}
C	3/15/77	62	1.50	90	0.93	--	5.6×10^{-5}
C	9/27/77	64	1.52	996	0.97	--	2.4×10^{-6}

TABLE 16. PHYSICAL CHARACTERISTICS OF IMPOUNDED TREATED SLUDGE CORES (Continued)

Pond	Coring Date	Solids Content, wt %	Density, g/cm^3 (wet)	Unconfined Compressive Strength, lb/in^2 (wet)	Density g/cm^3 (dry)	Porosity void fraction (volumetric)	Permeability Coefficient cm/sec
E	2/27/75	49	1.43	118	0.71	0.72	1.5×10^{-5}
E	2/27/75	--	--	--	--	--	2.7×10^{-5}
E	7/29/75	--	--	--	--	--	9.3×10^{-5}
E	1/14/76	52	1.43	24	0.74	0.70	1.2×10^{-5}
E	7/7/76	49	1.33	260	0.63	--	1.5×10^{-5}
E	3/15/77	53	1.30	--	0.69	--	1.6×10^{-6}
E	9/27/77	48	1.34	37	0.65	--	1.1×10^{-4}

from a point in the general vicinity of these ponds to serve as control samples. Single cores from each pond were taken using Shelby tubes, approximately 2 years after project initiation, at which time it was believed the leachate had penetrated the subsoil to a depth of approximately one foot. The purpose was to determine which chemical constituents (if any) of the sludge were retained in the soil. This alone is not a quantitative analysis but may serve at a later date as input information to assist in determining the potential for attenuation of sludge constituents in the soil during seepage. The test procedures are given in Appendix B.

The results show that concentrations at 1, 3, and 9 in. below the sludge and at comparable depths in the control samples indicate no significant variations in values with respect to these locations. Therefore, single values are given for each sample (Table 17) (see raw data in Appendix B). During the approximately 2-year period of soak time between pond initiation and core sampling, Pond D was totally saturated; Pond E had a sump at one end and surface water intermittently; and Pond C had surface water intermittently and seepage through bore holes and cracks. Using a coefficient of permeability of 5×10^{-7} cm/sec for the soil, it is reasonable to assume that the soil was saturated through the first foot. The data show a buildup of sulfate, chloride, and calcium by a factor of 3 over background, mercury by a factor of 2, and arsenic by a factor of 1.5. It is known that iron and lead are retained in soil; however, this is not evident in these data because the trace quantities of these elements in the leachate are insignificant when compared to the background concentrations in the control sample. The sensitivity of the test equipment was such that no determination could be made for cadmium or selenium. The conclusion is that there is some retention of some of the sludge constituents in the soil, thereby tending to reduce the concentrations in the seepage. The net impact of this on the quality of the seepage to groundwater cannot be determined from these data.

8.5 CLIMATOLOGICAL AND HYDROLOGICAL DATA

Daily measurements of rainfall, evaporation, wind, and temperature have been taken since 1975 at the pond site. Only the cumulative weekly rainfall data are being reported here. These data were plotted for the period from April 1975 to September 1976 and reported in Reference 2. Data from August 1976 through June 1978 are reported here, as shown in Figure 61.

Weekly measurements were made of the depths of water in the ponds, leachate wells, and groundwater wells. As shown in Figures 61 and 62, there is a correlation of the water levels in the leachate wells with precipitation. No precipitation data were taken from late in December 1977 through early February 1978 because of severe winter weather conditions. However, photographic records of the site show a heavy snow layer on the ground during that time. The melting of this snow layer is reflected in the leachate well water depth data in the following weeks even though the records show that precipitation during that time was not more than 0.1 to 0.2 in./week.

TABLE 17. ANALYSIS OF SHAWNEE POND SITE SOIL CORES FOR RETENTION OF A MAJOR AND MINOR SPECIES DUE TO SLUDGE SEEPAGE[a]

Source	Moisture, % (Wet Sediment)	Concentration in Dry Sediment							
		SO_4, %	Cl, %	Fe, %	Ca, %	Cd, ppm	Pb, ppm	As, ppm	Hg, ppm
Control	15	0.005	0.007	1.63	0.05	<0.05	8.7	8.9	0.012
Pond C	17	0.015	0.035	1.73	0.16	<0.05	9.5	12.3	0.019
Pond D	19	0.034	0.020	1.13	0.25	<0.05	8.6	7.8	0.030
Pond E	20	0.045	0.010	1.81	0.22	<0.05	10.6	13.5	0.030

[a] Analysis by B.J. Presley, Texas A&M, August 1977.

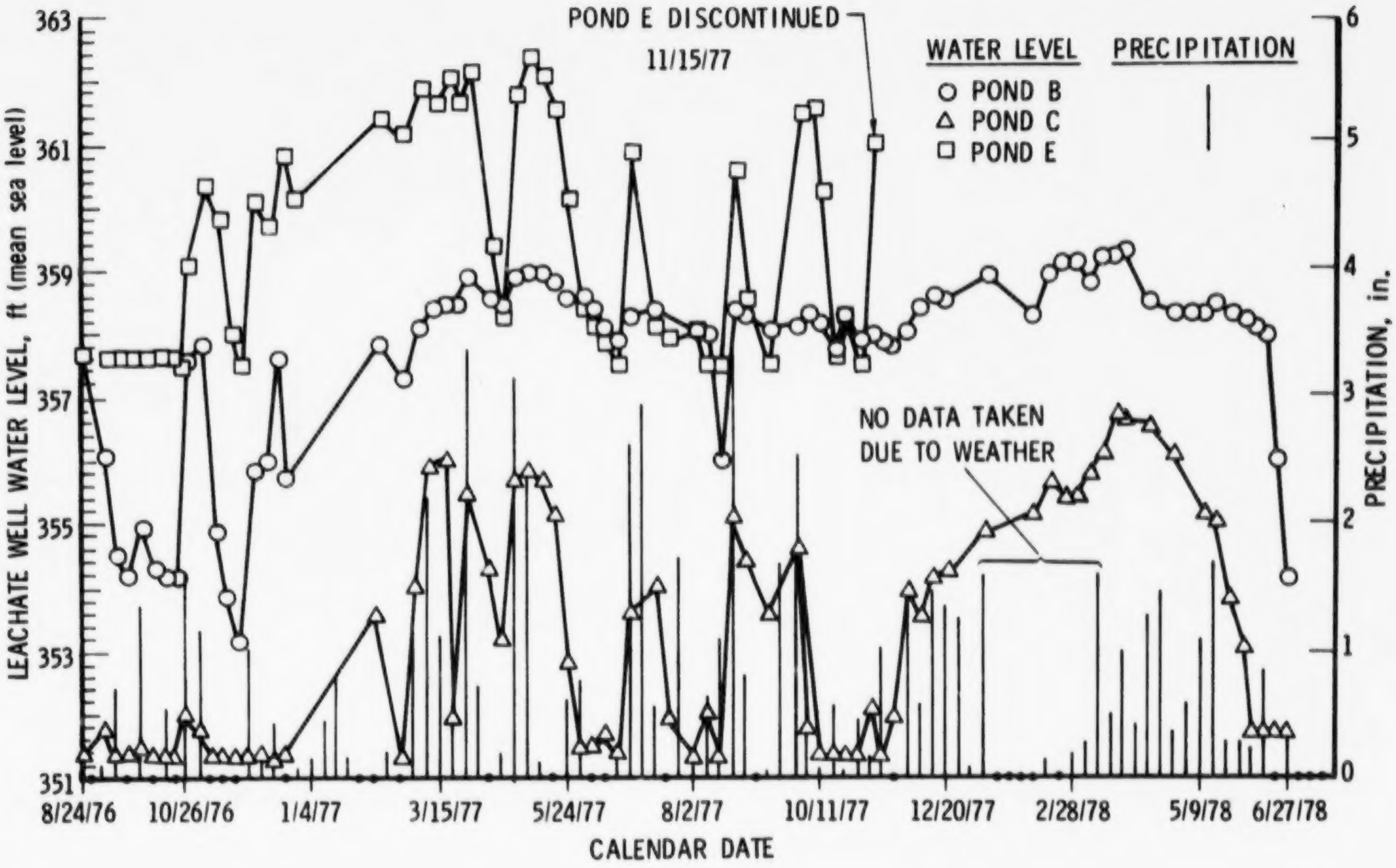


Figure 61. Comparison of precipitation and leachate well water level in Ponds B, C, and E.

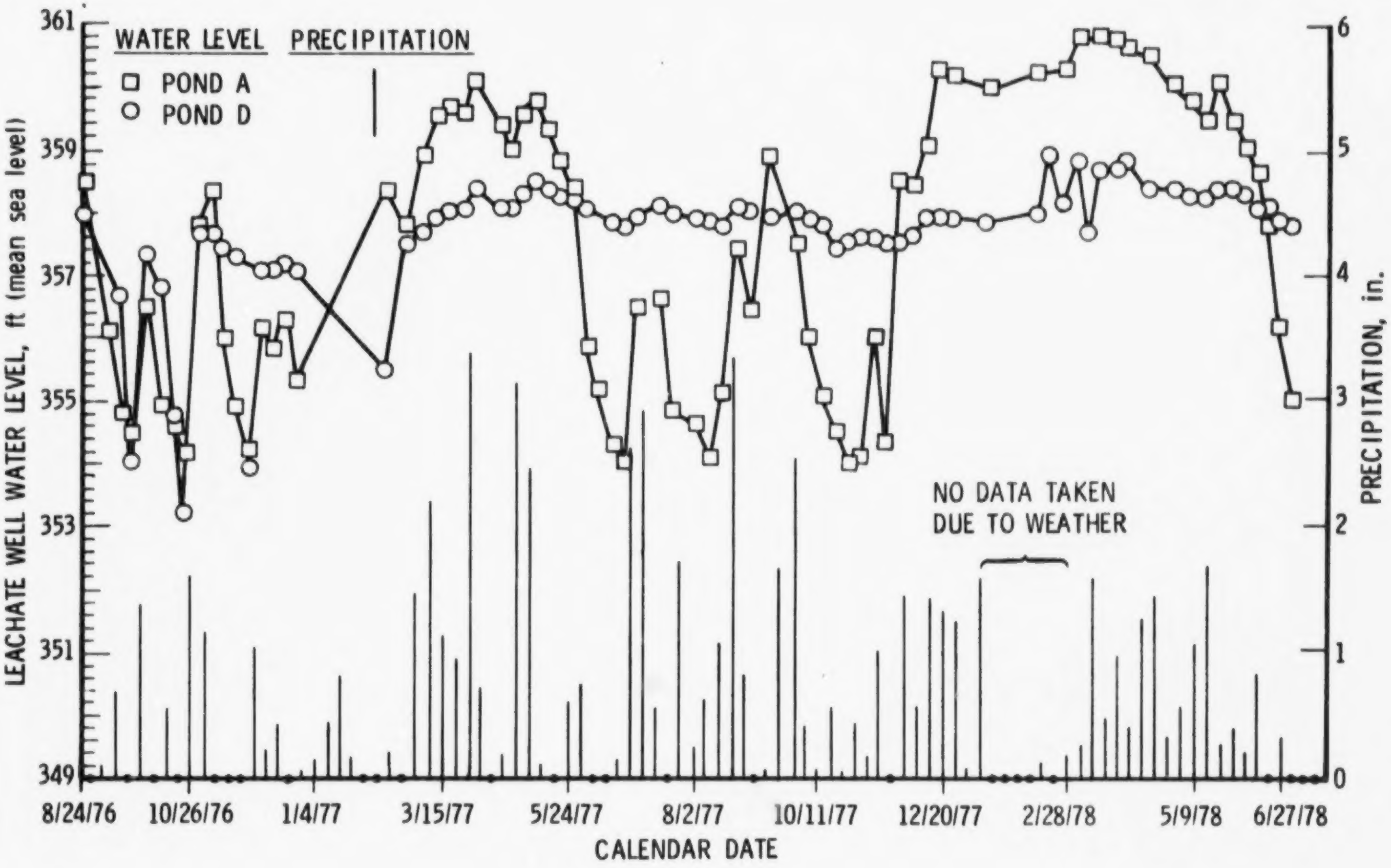


Figure 62. Precipitation as a function of water level in Ponds A and D.

SECTION IX

DISPOSAL COST ESTIMATES

9.1 BASE CONDITIONS

The costs for various FGD waste sludge disposal alternatives are a function of many variables including plant location, plant size, combustion characteristics, type of fuel burned, annual operating hours, disposal site lifetime, scrubber efficiency, limestone absorbent utilization, average annual capital charges, cost of land, depreciation of land and equipment, dollar base year, and distance from power plant to disposal site. Table 18 lists values used for these variables in this analysis.

Cost estimates for six cases were derived from vendor estimates, previous Aerospace work, and other literature on this subject, assuming two 500-MWe coal-fired units. The six cases examined are variations of two base cases. Table 19 is a summary of the two base case outputs for a limestone scrubber and a similar scrubber in which the sludge is oxidized to gypsum; it is based on a model derived in a previous study (Ref. 15). The costs for various disposal techniques are made using the quantities and costs for specific equipment and material for each variation. Costs for equipment and factors used to estimate the total cost are given in Table 20.

9.2 UNTREATED SLUDGE, INDIGENOUS LINER

In this option, the limestone scrubber base conditions apply. As can be seen in Table 19, the 30-yr average output of sludge is 500 acre-ft/yr. The ponds are constructed in indigenous soil with earthen berms. The side slopes of the berms are 2:1 (horizontal: vertical). A sludge depth of 30 ft is used for all ponds, and a 3-ft freeboard is allowed. Outside and inside berms have a top width of 20 and 10 ft, respectively. Total land area required to construct the site is 542 acres, including land needed for berms and road beds. Figure 63 shows a sketch of this pond.

The sludge is slurried to the site from the power plant via a pipeline system consisting of one 8-in. pipe which carries the waste to the pond and one 6-in. pipe which returns water to the plant. Redundancy is supplied by an additional 8-in. pipe, one 6-in. pipe, and attenant pumps; centrifugal pumps are used. Table 21 lists the costs associated with this option. Table 22 shows the results of this cost estimate in mills per kilowatt hour,

TABLE 18. SUMMARY OF BASE CONDITIONS

Items	Base Condition
Dollar Base	Mid-1980
Plant Characteristics	Two 500 MWe units, 0.75-lb coal/kWh
Coal Burned	3.5% sulfur 12,000 Btu/lb 14% fly ash
Annual Operating Hours	4250 hr, w/48.5% capacity factor for 30-yr life (average)
Plant Disposal Site Lifetime	30 yr
SO_2 Removal	90%
Sludge Generated	$2.4 \times 10^5 \times 2 = 4.8 \times 10^5$ tons/yr dry (general case) (Table 19) $2.45 \times 10^5 \times 2 = 4.9 \times 10^5$ tons/yr dry (gypsum case) (Table 19)
Limestone Utilization	80%, limestone case; 100%, gypsum case
Annual Capital Charges, 30-yr Average	17%
Cost of Land Used for Disposal	$5000/acre
Disposal Site	Within 1 mile of plant

TABLE 19. SUMMARY OF BASE CASE OUTPUTS: OUTPUT FORMAT FOR LIME AND LIMESTONE SCRUBBER

```
CASE  0- PROCESS TITLES AND OPTIONS
% SULFUR  FUEL,BTU   FUEL %    CAPACITY    FUEL BTU ABSORBENT % SO2 REM  % MOIST
 IN FUEL   PER LB     ASH         MW       PER KWH  UTILIZ     BY SCRUB.   IN WST

SULFITE-   DENSITY,  SODA ASH   PLANT
TO SULFATE WET WASTE MAKE UP  OPERATING
 RATIO     LB/FT3       %       HOURS


 OUTPUT:
  FUEL       TOTAL       SO2       SO2      ABSORBENT   SO2        SO2        SO2
 BURNED,    SULFUR      FORMED    REMOVED     USED   EMISSIONS EMISSIONS LB/M BTU
   T/H        T/H        T/H       T/H        T/H      T/H        LB/H

   ASH      PRECIP
  FORMED    CaCO3       CaSO3       CaSO4      % ASH    % CaCO3   % CaSO3   % CaSO4
   T/H        T/H        T/H         T/H    DRY WASTE  DRY WASTE DRY WASTE DRY WASTE

  TOTAL       TOTAL     TOTAL       TOTAL   TOTAL WET  TOTAL WET  TOTAL
 DRY WASTE WET WASTE DRY WASTE WET WASTE   VOL,FT3/   VOL,ACRE   BTU/HP
   T/H        T/H       T/Y         T/Y       YEAR       FEET


            LIMESTONE SCRUBBER
     3.50    12000.     14.00       500.      9000.      80.00      90.00      50.00
   3.0:1.     88.60      0.0       4250.

OUTPUT:
  187.500     6.562    13.125     11.812     23.071      1.313      2625.      0.583
   26.250     4.614    17.857      7.937     46.331      8.144     31.518     14.008
   56.658   113.316 2.408E 05 4.816E 05 1.087E 07    249.567 4.500E 09



            LIMESTONE SCRUBBER
     3.50    12000.     14.00       500.      9000.      80.00      90.00      50.00
   3.0:1.     88.60      0.0       7000.

OUTPUT:
  187.500     6.562    13.125     11.812     23.071      1.313      2625.      0.583
   26.250     4.614    17.857      7.937     46.331      8.144     31.518     14.008
   56.658   113.316 3.966E 05 7.932E 05 1.791E 07    411.052 4.500E 09

            SLUDGE FORCE-OXIDIZED TO GYPSUM
            LIMESTONE SCRUBBER
     3.50    12000.     14.00       500.      9000.     100.00      90.00      35.00
   0.0:1.     87.36      0.0       4250.

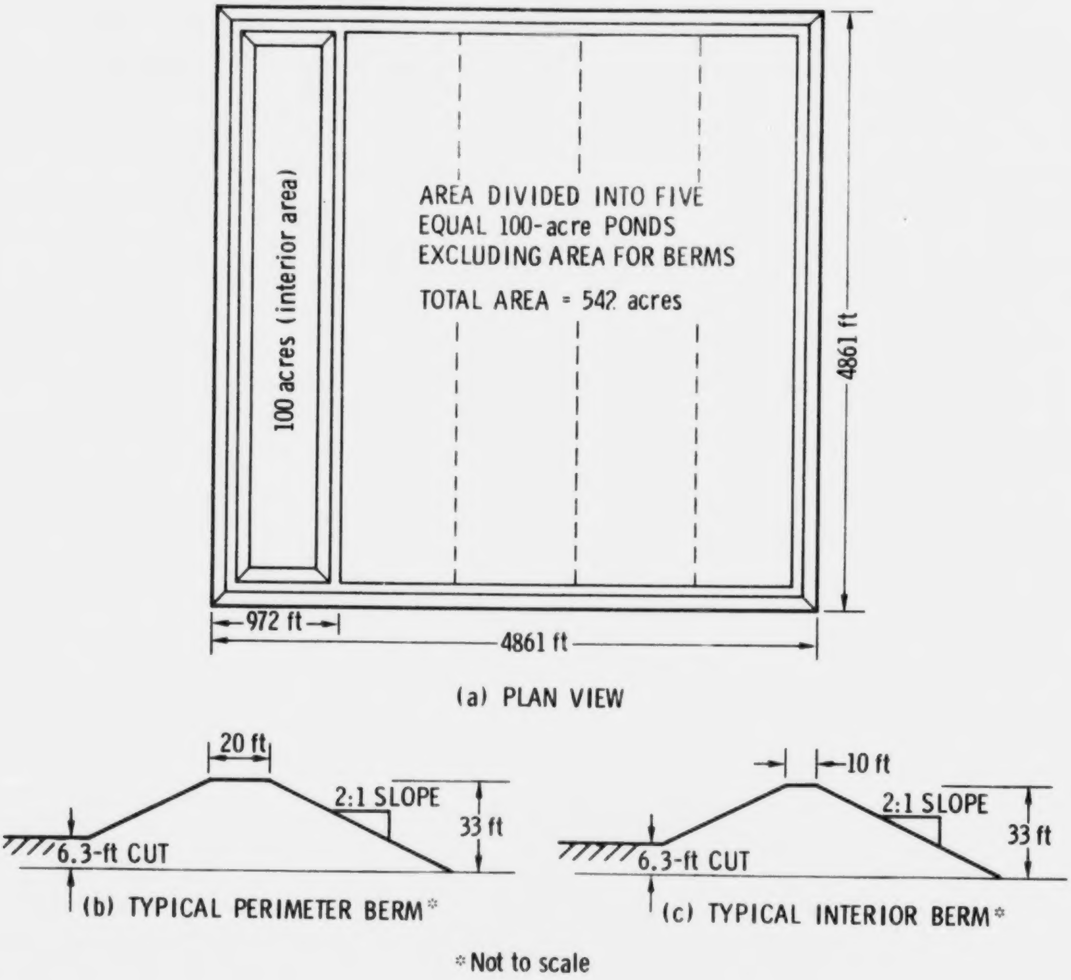
OUTPUT:
  187.500     6.562    13.125     11.812     18.457      1.313      2625.      0.583
   26.250     0.0       0.0       31.746     45.262      0.0         0.0      54.738
   57.996    89.225 2.465E 05 3.792E 05 8.681E 06    199.298 4.500E 09


            SLUDGE FORCE-OXIDIZED TO GYPSUM
            LIMESTONE SCRUBBER
     3.50    12000.     14.00       500.      9000.     100.00      90.00      35.00
   0.0:1.     87.36      0.0       7000.

OUTPUT:
  187.500     6.562    13.125     11.812     18.457      1.313      2625.      0.583
   26.250     0.0       0.0       31.746     45.262      0.0         0.0      54.738
   57.996    89.225 4.060E 05 6.246E 05 1.430E 07    528.256 4.500E 09
```

TABLE 20. COMPONENT COSTS

Unit, Process, or Operation	Cost	Ref.
Capital Costs		
Earthwork	$1.50/yd^3$	16
Clearing	$500/acre	16
Rip-Rap	$20/yd^2$	16
Lining (Hypalon-30 or Equivalent) Installed	$4.98/yd^2$	21
Sand	$4/ton	Conrock of
Gravel	$4/ton	Los Angeles
Pumps:		
Limestone Case		
Water	$34,010	17
Slurry	$118,140	17
Gypsum Case		
Water	$128,880	17
Slurry	$408,120	17
Pipes		
6-in. Diam.	$12.74/ft	Imperial Pipe
8-in. Diam.	$17.14/ft	and Hood Corp.
Electrical Equipment	$81,740	18
Instruments:	$115,900	18
Underdrained System	$35/flow meter	22
Buildings	$63,440	18
Fence	$12.20/ft	18
Gypsum Oxidation Equipment		
Compressors	$633,606	17
Tanks	$14,692	17
Land	$5,000/acre	--
Engineering	10%	--
Contingency	12%	--
Miscellaneous	0.5%	19
Startup and Modification	6.7%	19
Interest During Construction	16%	23
Annual Costs		
Maintenance	4% capital equip.	18, 19
Power	$0.029/kWhr	18, 19
Labor and Supervision	$17.05/hr	20
Analysis	$17.00/hr	19



100 acres (interior area)
AREA DIVIDED INTO FIVE
EQUAL 100-acre PONDS
EXCLUDING AREA FOR BERMS
TOTAL AREA = 542 acres
4861 ft
972 ft
4861 ft
(a) PLAN VIEW
20 ft
2:1 SLOPE
33 ft
6.3-ft CUT
(b) TYPICAL PERIMETER BERM*
10 ft
2:1 SLOPE
33 ft
6.3-ft CUT
(c) TYPICAL INTERIOR BERM*
*Not to scale

Figure 63. Limestone sludge pond: 100-acre pond area.

TABLE 21. COST ESTIMATE FOR UNTREATED POND, INDIGENOUS LINER

(Five 100-Acre Ponds)

Capital Costs	
Construction	
Clearing (542.5 acres @ \$500/acre)	\$ 271,000
Cut/Embankment (3,771,205 yd^3 @ \$1.50/yd^3)	5,660,000
Rip-Rap (30,263 yd^2 @ \$20/yd^2)	605,000
Equipment	
Process (pumps)	304,000
Pipes (2-mi 8-in. pipe and 2-mi 6-in. pipe)	316,000
Electrical	82,000
Instrumentation	116,000
Building/Fencing (19,493-ft fence)	301,000
Total Capital Costs plus Equipment	7,660,000
Engineering (10%)	766,000
Miscellaneous Services (0.5%)	38,300
	8,460,000
Contingency (12%)	1,020,000
	9,480,000
Startup and Modification Allowance (6.7%)	635,000
Interest During Construction (16%)	1,520,000
Land (542.5 acres @ \$5000/acre)	2,710,000
Total	\$ 14,300,000
Operations & Maintenance (O&M) Costs•	
First Year O&M Costs:	
Maintenance (4% of capital equipment)	\$ 45,000
Power	18,000
Labor and Supervision	149,000
Analysis (1000 hr @ \$17/hr)	17,000
	\$ 229,000

TABLE 22. COMPUTATION OF LEVELIZED COSTS FOR UNTREATED POND, INDIGENOUS LINER

Average Annual Capital Charges K = 0.17

Life of Installation N = 30

Capital Recovery Factor CRF = 0.17 $\left[CRF = K/\left[1-(1+K)^{-N}\right]\right]$

Levelized Capital Cost = CRF x Capital Cost = 0.17 (14,300,000)= 2,430,000

Inflation Rate g = 0.07

Average Annual O&M Charges K' = 0.09 $\left[K' = (K-g)/(1+g)\right]$

O&M Capital Recovery Factor CRF' = 0.10 $\left[CRF' = K'/\left[1-(1+K')^{-N}\right]\right]$

Levelized O&M Cost = (O&M cost/CRF') x CRF = 389,000

Total Levelized Cost = 2,430,000 + 389,000 = 2,820,000

$$\frac{\$2,820,000 \times 1000}{4.25 \times 10^{9}\ \text{kWh}} = \$\ .66\ \text{mills/kWh}$$

$$\frac{\$2,820,000}{4.8 \times 10^{5}\ \text{ton dry sludge}} = \$\ 5.88/\text{ton dry sludge}$$

$$\frac{\$2,820,000}{0.75\ \frac{\text{lb}}{\text{kWh}} \times \frac{\text{ton}}{2000\ \text{lb}} \times 4.25 \times 10^{9}\ \text{kWh}} = \$\ 1.77/\text{ton coal}$$

\$14.30/kW

dollars per ton of sludge (dry), dollars per ton of coal, and capital investment in dollars per kilowatt hour.

9.3 UNTREATED SLUDGE, PVC LINED

This case is very similar to the indigenously lined pond. Pond sizes and other equipment such as pumps and pipes are identical. There is an additional capital cost of $12,900,000 for liner material (such as 30-mil Hypalon at $\$4.98/\text{yd}^2$, installed). Tables 23 and 24 show the cost computations and results for this case.

9.4 UNTREATED SLUDGE, UNDERDRAINED

For the underdrain design, a maximum pond section of about 50 acres was chosen. Although this disposal technique can accommodate larger sections, this size was chosen to simplify the underdrainage system, with an adjacent pond acting as a backup unit. In effect, two ponds would always be available with separate but connecting plumbing systems. When the first one is filled (after about 2 years) and capped with clay, a third pond would be put into service, and the second pond would become the primary active unit - and so on (Figure 64). With smaller ponds, more berms are required and, thus, more land and earthwork. Compared to nondrained ponds, costs are increased because of the need for a porous base (sand, gravel, and bottom ash) and additional pipes and fittings. With this type of system, under most conditions a liner is not required even for soils with a permeability coefficient as large as 10^{-5} cm/sec. For this approach, then, the porous base completely dominates the capital costs. Therefore, a pond designed for a minimum sand bed depth is the minimum cost design for this type of disposal. The thinner the porous bed the greater the number of drainage pipes would be required, but because of the comparatively higher cost of porous bed compared to pipe installation, the thinner bed appears to be more appropriate. The variation of drainage pipe spacing as a function of porous bed depth is discussed in Section 8.1.7. Estimates for disposal costs are given in Tables 25 and 26.

9.5 GYPSUM, INDIGENOUS LINER

Two gypsum cases were examined, both slurried to a pond, one indigenously lined and the other synthetically lined. For this alternative, the sludge is oxidized to gypsum by means of an integrated forced-oxidation system. A 15% solids slurry is pumped to the disposal pond where the gypsum settles to approximately 65% solids. Since less gypsum sludge at 65% solids is produced than limestone sludge at 50% solids, a smaller gypsum pond size is required. A sketch of a gypsum site is shown in Figure 65. The land area required is 443 acres for ponds containing gypsum at a depth of 30 ft. This acreage accounts for berms and road beds.

The waste is slurried to the pond through a system of four parallel 8-in. pipes. Return water is piped through two 8-in. pipes. Redundancy is supplied by six additional 8-in., two-way pipes. The other major capital expenditure in this alternative is the cost of the oxidation itself, e.g.,

TABLE 23. COST ESTIMATE FOR UNTREATED POND, SYNTHETIC LINER

(Five 100-Acre Ponds)

Capital Costs		
Construction		
Clearing (542.5 acres @ $ 500/acre)		$ 271,000
Cut/Embankment (3,771,205 yd^3 @ $1.50 yd^3)		5,660,000
Synthetic Liner (2,581,209 yd @ 4.98/yd^2)		12,900,000
Equipment		
Process (pumps)		304,000
Pipes (2-mi 8-in. pipe and 2-mi 6-in. pipe)		316,000
Electrical		82,000
Instrumentation		116,000
Building/Fencing (19,493 ft fence)		301,000
		20,000,000
Engineering (10%)		2,000,000
Miscellaneous Services (0.5%)		100,000
		22,100,000
Contingency (12%)		2,650,000
		24,800,000
Startup and Modification Allowance (6.7%)		1,660,000
Interest During Construction ([illegible]%)		3,970,000
Land (542.5 acres @ $5000/acre)		2,710,000
	Total	$33,100,000
Operations & Maintenance (O&M) Costs		
First Year O&M Costs:		
Maintenance (4% of capital equipment)		$ 44,800
Power		18,000
Labor and Supervision		149,000
Analysis (1000 hrs @ $17/hr)		17,000
		$ 229,000

TABLE 24. COMPUTATION OF LEVELIZED COSTS FOR UNTREATED POND, SYNTHETIC LINER

Average Annual Capital Charges K = 0.17

Life of Installation N = 30

Capital Recovery Factor CRF = 0.17

Levelized Capital Cost = CRF x Capital Cost = 0.17 (33,100,000) = 5,630,000

Inflation Rate g = 0.07

Average Annual O&M Charges K' = 0.09

O&M Capital Recovery Factor CRF' = 0.10

Levelized O&M Cost = (O&M cost/CRF') x CRF = 389,000

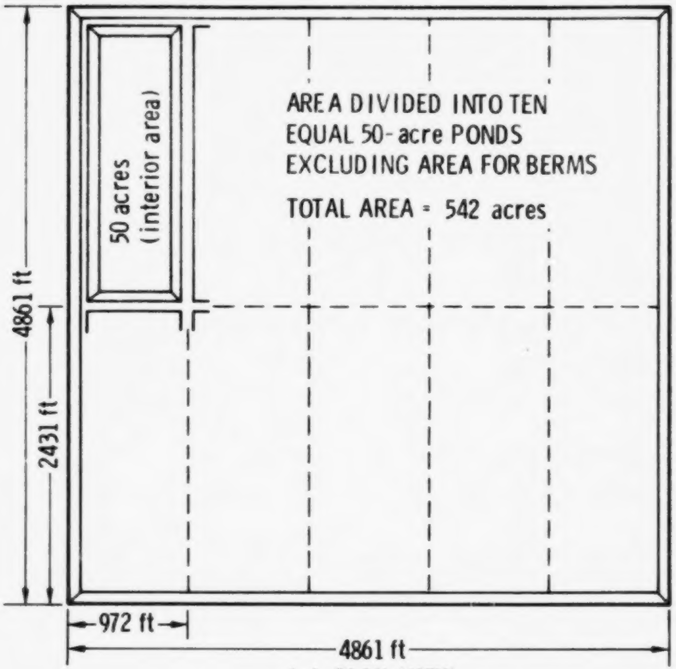
Total Levelized Cost = 5,630,000 + 389,000 = 6,020,000

$$\frac{\$6,020,000}{4.25 \times 10^9 \text{ kWh}} = \$\ 1.42 \text{ mills/kWh}$$

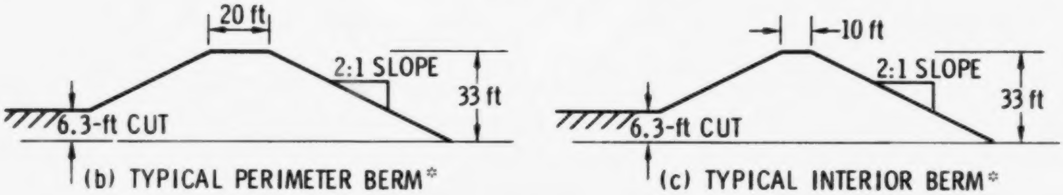
$$\frac{\$6,020,000}{4.8 \times 10^5 \text{ ton dry sludge}} = \$12.54\text{/ton dry sludge}$$

$$\frac{\$6,020,000}{0.75\ \frac{\text{lb}}{\text{kWh}} \times \frac{\text{ton}}{2000\text{ lb}} \times 4.25 \times 10^9 \text{ kWh}} = \$\ 3.78\text{/ton coal}$$

$33.10/kW


50 acres
(interior area)
AREA DIVIDED INTO TEN
EQUAL 50-acre PONDS
EXCLUDING AREA FOR BERMS
TOTAL AREA = 542 acres
4861 ft
2431 ft
972 ft
4861 ft

(a) PLAN VIEW


20 ft
2:1 SLOPE
33 ft
6.3-ft CUT
10 ft
2:1 SLOPE
33 ft
6.3-ft CUT

(b) TYPICAL PERIMETER BERM*

(c) TYPICAL INTERIOR BERM*

*Not to scale

Figure 64. Limestone sludge pond: 50-acre sections for underdrainage.

TABLE 25. COST ESTIMATE FOR UNTREATED SLUDGE, UNDERDRAINED POND

(Ten 50-Acre Ponds)

Capital Costs	
Construction	
Clearing (579 acres @ \$500/acre)	\$ 289,000
Cut/Embankment (4,472,543 yd^3 @ \$1.50/yd^3)	6,710,000
Rip-Rap (32,300 yd^2 @ \$20/yd^2)	646,000
Sand (1,149,835 tons @ \$4.00/ton)	4,600,000
Gravel (15,572 tons @ \$4.00/ton)	62,300
Equipment	
Process (pumps)	304,000
Pipes (\$434,222 for underdrain + 2-mi, 8-in. pipe) and 2-mi 6-in. pipe)	750,000
Electrical	82,000
Instrumentation (10 flow meters included)	117,000
Building/Fencing (20,101 ft)	309,000
	13,900,000
Engineering (10%)	1,390,000
Miscellaneous Services (0.5%)	69,500
	15,400,000
Contingency (12%)	1,850,000
	17,300,000
Startup and Modification Allowance (6.7%)	1,160,000
Interest During Construction (16%)	2,770,000
Land (579 acres @ \$5000/acre)	2,900,000
Total	\$24,100,000

TABLE 25. COST ESTIMATE FOR UNTREATED SLUDGE, UNDERDRAINED POND (Continued)

(Ten 50-Acre Ponds)

Operations & Maintenance (O&M Costs)

First Year O&M Costs:	
Maintenance (4% of capital equipment)	$ 62,500
Power	18,000
Labor and Supervision	149,000
Analysis (1000 hrs@ $17/hr)	17,000
	$247,000

TABLE 26

COMPUTATION OF LEVELIZED COSTS FOR UNTREATED SLUDGE, UNDERDRAINED

Average Annual Capital Charges K = 0.17

Life of Installation N = 30

Capital Recovery Factor CRF = 0.17

Levelized Capital Cost = CRF x Capital Cost = 0.17 (24,100,000) = 4,100,000

Inflation Rate g = 0.07

Average Annual O&M Charges K' = 0.09

O&M Capital Recovery Factor CRF' = 0.10

Levelized O&M Cost = (O&M cost/CRF') x CRF = 420,000

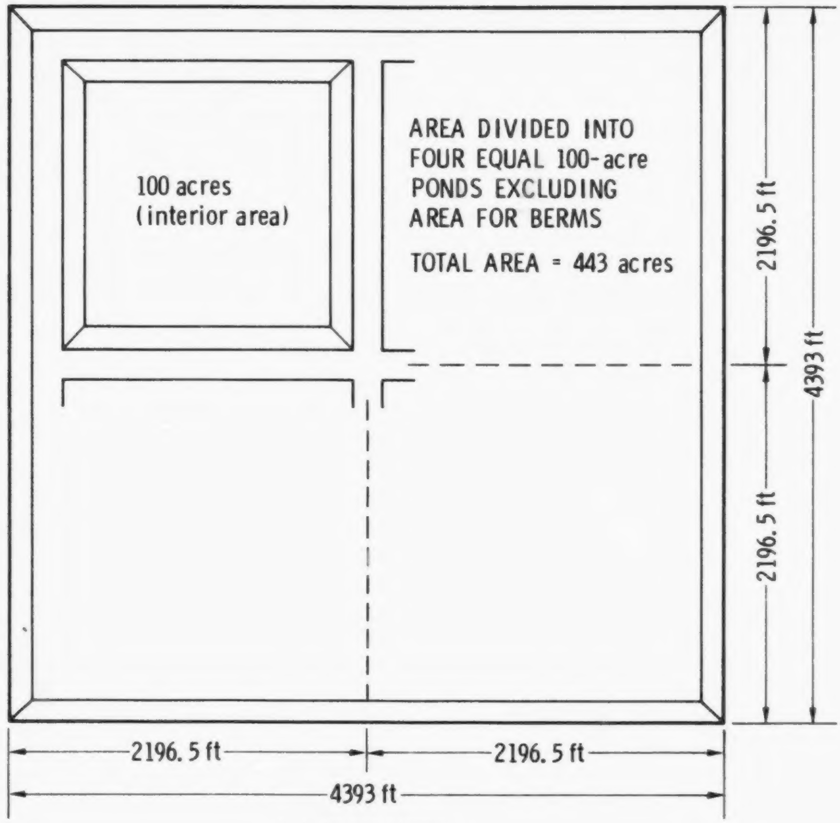
Total Levelized Cost = 4,100,000 + 420,000 = 4,520,000

$$\frac{\$4,520,000}{4.25 \times 10^9 \text{kWh}} = 1.06 \text{ mills/kWh}$$

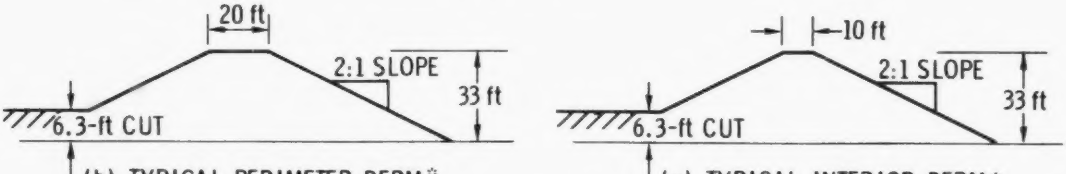
$$\frac{\$4,520,000}{4.8 \times 10^5 \text{ ton dry sludge}} = \$9.42\text{/ton dry sludge}$$

$$\frac{\$4,520,000}{0.75 \frac{\text{lb}}{\text{kWh}} \times \frac{\text{ton}}{2000 \text{ lb}} \times 4.25 \times 10^9 \text{kWH}} = \$\ 2.84\text{/ton coal}$$

$24.10 /kW


100 acres
(interior area)
AREA DIVIDED INTO
FOUR EQUAL 100-acre
PONDS EXCLUDING
AREA FOR BERMS
TOTAL AREA = 443 acres
2196.5 ft
2196.5 ft
4393 ft
2196.5 ft
2196.5 ft
4393 ft

(a) PLAN VIEW


20 ft
2:1 SLOPE
33 ft
6.3-ft CUT
10 ft
2:1 SLOPE
33 ft
6.3-ft CUT

(b) TYPICAL PERIMETER BERM* (c) TYPICAL INTERIOR BERM*

*Not to scale

Figure 65. Gypsum sludge pond: 100-acre pond area.

compressors, tanks, and lines: $5,025,943. Some cost is saved by the reduction in land requirement because the material is disposed of with less water than in the limestone system. The estimates for the disposal cost for gypsum sludge slurried to a pond with indigenous liner is given in Tables 27 and 28.

9.6 GYPSUM, LINED

This case is similar to the other gypsum case with the addition of a $9,810,000 capital investment to install a liner at $4.98/yd^2. This additional cost is offset slightly by a reduction of $438,000 because rip-rap is not included as in the first gypsum case. Tables 29 and 30 contain the result of this gypsum disposal option cost estimate.

9.7 CHEMICAL TREATMENT

Costs for chemical treatment were taken from a 1976 Aerospace report (Ref. 1) and adjusted to mid-1980 values. Three systems were estimated in this work. Table 31 summarizes the average results for this disposal alternative. A major difference between this method and the underdrain approach is that only one large site is needed for chemically treated sludge since the treated material behaves like a low-grade concrete; thus, it has structural properties and does not necessarily require earthen berms to contain it. One large site reduces land requirements by about 11%, thereby lowering initial investment.

9.8 COST COMPARISONS

The costs for the six disposal alternatives discussed are listed in Table 32 in units of dollars per ton of dry sludge, dollars per ton of coal, and mills per kilowatt hour. Also listed is the capital cost comparison in dollars per kilowatt hour. In all cases, the cost of disposal includes fly ash in the sludge.

TABLE 27
COST ESTIMATE FOR SLURRIED GYPSUM
(FOUR 100-ACRE PONDS)

Capital Costs	
Construction	
Clearing (443 acres @ $\$500$/acre)	222,000
Cut/Embankment (3,310,439 yd^3 @ $\$1.50/\text{yd}^3$	4,970,000
Rip-Rap	438,000
Equipment	
Process (slurry pumps + oxidation equipment)	6,100,000
Pipes (12-mi 8" pipe)	1,090,000
Electrical	82,000
Instrumentation	116,000
Building/Fencing (17,573 ft)	278,000
	13,300,000
Engineering (10%)	1,330,000
Miscellaneous Services (0.5%)	665,000
	15,300,000
Contingency (12%)	1,840,000
	17,100,000
Startup and Modification Allowance (6.7%)	1,150,000
Interest During Construction (16%)	2,740,000
Land (443 acres @ $\$5000$/acre)	2,220,000
	23,200,000
Operations & Maintenance (O&M) Costs	
1st Year O&M Costs:	
Maintenance (4% of capital equipment)	$\$$ 306,000
Power	160,000
Labor and Supervision	149,000
Analysis (1000 hr @ $\$17$/hr)	17,000
	$\$$ 632,000

TABLE 28

COMPUTATION OF LEVELIZED COSTS FOR SLURRIED GYPSUM, INDIGENOUS LINER

Average Annual Capital Charges K = 0.17
Life of Installation N = 30
Capital Recovery Factor CRF = 0.17
Levelized Capital Cost = CRF x Capital Cost = 0.17 (23,200,000) = 3,940,000

Inflation Rate g = 0.07
Average Annual O&M Charges K' = 0.09
O&M Capital Recovery Factor CRF' = 0.10
Levelized O&M Cost = (O&M cost/CRF') x CRF = 1,070,000
Total Levelized Cost = 3,940,000 + 1,070,000 = 5,010,000

$$\frac{\$5,010,000}{4.25 \times 10^9 \text{ kWh}} = \$\ 1.18 \text{ mils/kWh}$$

$$\frac{\$5,010,000}{4.9 \times 10^5 \text{ ton dry sludge}} = \$10.22 \text{ /ton dry sludge}$$

$$\frac{\$5,010,000}{0.75 \frac{\text{lb}}{\text{kWh}} \times \frac{\text{ton}}{2000 \text{ lb}} \times 4.25 \times 10^9 \text{ kWh}} = \$3.14 \text{ /ton coal}$$

$23.20 /kW

TABLE 29

COST ESTIMATE FOR SLURRIED GYPSUM, SYNTHETIC LINER (FOUR 100-ACRE PONDS)

Capital Costs	
Construction	
Clearing (443 acres @ $500/acre)	222,000
Cut/Embankment $(3,310,439\ \mathrm{yd}^3 @ \$1.50/\mathrm{yd}^3)$	4,970,000
Synthetic Liner $(1,970,000\ \mathrm{yd}^2 @ \$4.98/\mathrm{yd}^2)$	9,810,000
Equipment	
Process (slurry pumps + oxidation equipment)	6,300,000
Pipes (12-mi 8 in. pipe)	1,090,000
Electrical	82,000
Instrumentation	116,000
Building/Fencing (17,573 ft)	278,000
	22,900,000
Engineering (10%)	2,290,000
Miscellaneous Service (0.5%)	115,000
	25,300,000
Contingency (12%)	3,040,000
	28,300,000
Startup and Modification Allowance (6.7%)	1,900,000
Interest During Construction (16%)	4,530,000
Land (443 acres @ $5000/acre)	2,220,000
Total	$37,000,000
Operations & Maintenance (O&M) Costs	
1st Year O&M Costs:	
Maintenance (4% of capital equipment)	$314,000
Power	160,000
Labor and Supervision	149,000
Analysis (1000 hr @ $17/hr)	17,000
	$640,000

TABLE 30
COMPUTATION OF LEVELIZED COSTS FOR SLURRIED GYPSUM, SYNTHETIC LINER

Average Annual Capital Charges K = 0.17
Life of Installation N = 30
Capital Recovery Factor CRF = 0.17
Levelized Capital Cost = CRF x Capital Cost = 0.17 (37,000,000) = 6,290,000

Inflation Rate g = 0.07
Average Annual O&M Charges K' = 0.09
O&M Capital Recovery Factor CRF' = 0.10
Levelized O&M Cost = (O&M Cost/CRF') x CRF = 1,090,000
Total Levelized Cost = 6,290,000 + 1,090,000 = 7,350,000

$$\frac{\$7,380,000}{4.25 \times 10^{9}\ \text{kWh}} = 1.74\ \text{mills/kWh}$$

$$\frac{\$7,380,000}{4.9 \times 10^{5}\ \text{ton dry sludge}} = \$15.06/\text{ton dry sludge}$$

$$\frac{\$7,380,000}{0.75\,\frac{\text{lb}}{\text{kWh}} \times \frac{\text{ton}}{2000\ \text{lb}} \times 4.25 \times 10^{0}\ \text{kWh}} = \$4.63\ /\text{ton coal}$$

$37.00/kW

TABLE 31

CHEMICALLY TREATED SLUDGE DISPOSAL COST UPDATE

	1977	1980
Average Annual Cost	9.70/ton dry sludge 1.06 mills/kWh 2.95/ton coal	11.83/ton dry sludge 1.24 mills/kWh 3.60/ton coal
	1977	1980
Capital Investment	$13,595,440 $13.60/kW	$16,586,436 $16.59/kW

TABLE 32

COST COMPARISON OF DISPOSAL ALTERNATIVES

CASE	Mills/kWh	$/Ton(Dry)	$/Ton Coal	Capital Cost, $/kW
Limestone, Indigenous Pond	0.66	5.88	1.77	14.30
Limestone, Hypalon 30 Liner Added	1.42	12.54	3.78	33.10
Limestone, Underdrained	1.06	9.42	2.84	24.10
Gypsum, Indigenous Pond	1.18	10.22	3.14	23.20
Gypsum, Hypalon 30 Liner Added	1.74	15.06	4.63	37.00
Chemically Treated	1.24	11.83	3.60	16.59

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APPENDIX A

WATER ANALYSIS DATA

```
POND A SUPERNATE

WELL DESIG        PSA         PSA         PSA         PSA         PSA         PSA         PSA         PSA  
DATE        741022.0000 741209.0000 750212.0000 750428.0000 750707.0000 750901.0000 751107.0000 760106.0000
REC NO.        100.0000    120.0000    140.0000    160.0000    180.0000    200.0000    220.0000    240.0000
PH               8.1000      8.2000      8.5000      8.0000      0.0000      8.2000      8.4000      7.7000
ALKALINITY     100.0000     60.0000     49.0000     43.0000      0.0000     34.0000     40.0000     36.0000
CHLORIDE      2000.0000    980.0000    630.0000    250.0000    300.0000    440.0000    330.0000    300.0000
COD              0.0000     60.0000     24.0000     14.0000     20.0000     29.0000     38.0000     27.0000
COND          8000.0000   4600.0000   3200.0000   1800.0000   2500.0000   3600.0000   3700.0000   1800.0000
TDS           7100.0000   4300.0000   2800.0000   1600.0000   2300.0000   3600.0000   3500.0000   1900.0000
TSS             18.0000     27.0000      6.0000      7.0000     14.0000      6.0000     20.0000     31.0000
SULFATE       1400.0000   1100.0000   1100.0000    570.0000    810.0000   1900.0000   1300.0000    540.0000
ARSENIC           .0300       .0150 <     .0050 <     .0050       .0060       .1200       .0190 <     .0050
BORON           16.0000      2.2000      8.8000      0.0000      5.3000      8.3000     14.0000      0.0000
CALCIUM       2000.0000   1100.0000    880.0000    480.0000    640.0000   1200.0000   1200.0000    670.0000
LEAD        <     .0100 <     .0100 <     .0100       .0160 <     .0100       .0200 <     .0100       .0230
MAGNESIUM      140.0000     71.0000     48.0000     20.0000     21.0000     26.0000     34.0000     19.0000
MERCURY           .0005 <     .0002       .0003 <     .0002       .0017 <     .0002 <     .0002       .0014
SELENIUM    <     .0020 <     .0020 <     .0020 <     .0020       .0020 <     .0020 <     .0010 <     .0020
SULFITE          0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SODIUM           0.0000      0.0000      0.0000      0.0000     16.0000     23.0000     27.0000     20.0000
TOTAL ELEM    5556.0425   3253.2272   2666.8173   1320.0232   1792.3197   3597.4422   2905.0302   1549.0314
```

```
POND A SUPERNATE

WELL DESIG        PSA         PSA         PSA         PSA         PSA         PSA         PSA  
DATE        760301.0000 760706.0000 770302.0000 770505.0000 771216.0000 780316.0000 780511.0000
REC NO.        260.0000    280.0000    300.0000    320.0000    340.0000    360.0000    380.0000
PH               7.8000      7.4000      7.5000      6.7000      6.8000      7.3000      7.3000
ALKALINITY      26.0000     84.0000     55.0000     37.0000     43.0000     78.0000     42.0000
CHLORIDE       130.0000     42.0000     74.0000     18.0000      5.0000      4.0000      5.0000
COD             58.0000     32.0000     22.0000     10.0000     24.0000     18.0000     12.0000
COND          1500.0000    930.0000   1400.0000    800.0000    450.0000    460.0000    900.0000
TDS           1500.0000   1800.0000   1500.0000    710.0000    300.0000    300.0000    720.0000
TSS             16.0000      7.0000      3.0000      1.0000     10.0000      6.0000      3.0000
SULFATE        690.0000    320.0000    820.0000    430.0000    160.0000     86.0000    440.0000
ARSENIC     <     .0100       .0150       .0070       .0060 <     .0020 <     .0020       .0040
BORON            3.8000      2.0000      3.6000      1.7000       .2200       .1400       .3800
CALCIUM        540.0000    240.0000    390.0000    170.0000     98.0000     64.0000    200.0000
LEAD        <     .0100 <     .0100 <     .0100 <     .0100 <     .0100 <     .0100 <     .0100
MAGNESIUM       17.0000     12.0000     17.0000      7.2000      7.6000      4.3000      8.4000
MERCURY     <     .0002 <     .0002 <     .0002 <     .0020 <     .0002 <     .0002 <     .0002
SELENIUM    <     .0040       .0030       .0080 <     .0020 <     .0020 <     .0020       .0020
SULFITE          0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SODIUM          15.0000      8.9000      8.6000      2.6000      3.4000      1.8000      1.9000
TOTAL ELEM    1395.8242    624.9282   1313.2252    629.5200    274.2342    160.2542    655.6962
```

```
POND A SUPERNATE    --- AEROSPACE ---

WELL DESIG     PSA         PSA         PSA         PSA         PSA         PSA         PSA    
DATE       741028.0000 750428.0000 751103.0000 760415.0000 770505.0000 780309.0000 780316.0000
REC NO.       400.0000    420.0000    440.0000    460.0000    480.0000    500.0000    520.0000
FH              7.7100      7.6800      7.1300      7.0800      6.6900      7.9200      7.8200
ALKALINITY     59.0000     43.0000     41.0000     47.0000     34.0000     61.0000     54.0000
CHLORIDE     1600.0000    390.0000    710.0000    350.0000     96.0000      4.5000      4.5000
COD             0.0000     50.0000     65.0000      0.0000      0.0000      0.0000      0.0000
COND         7800.0000   1800.0000   3440.0000   2080.0000    780.0000    282.0000    317.0000
TDS          5850.0000   1540.0000   3870.0000   2080.0000    656.0000    190.0000    258.0000
TSS            10.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SULFATE      1500.0000    650.0000   1675.0000    750.0000    427.0000     82.0000     95.0000
ARSENIC         0.0000       .0050       .0040 <     .0010       .0040       .0070      0.0000
BORON          22.8000      1.9000      8.8000      6.3000       .9000 <     .5000      1.4000
CALCIUM      1480.0000    540.0000    760.0000    455.0000    190.0000     46.0000     47.0000
LEAD             .0939       .1000 <     .0100 <     .0100       .0850       .1200      0.0000
MAGNESIUM        .6000      4.6000     33.0000     18.0000      6.2000      6.1000      6.2000
MERCURY         0.0000       .0002       .0003       .0013 <     .0001       .0005      0.0000
SELENIUM        0.0000       .0070       .0060       .0310 <     .0010       .0004      0.0000
SULFITE         1.3000       .2000 <     .1000      0.0000      0.0000      0.0000      0.0000
SODIUM          0.0000      0.0000     30.0000     18.0000      3.7000     82.0000     95.0000
TOTAL ELEM   4604.7930   1586.8122   3216.9203   1597.3433    723.8901    221.2279    249.1000
```

POND A LEACHATE

WELL DESIG	LWA1	LWA1	LWA1	LWA1	LWA1	LWA1	LWA1	LWA1
DATE	741015.0000	741209.0000	750211.0000	750428.0000	750707.0000	750901.0000	751103.0000	760106.0000
REC NO.	540.0000	560.0000	580.0000	600.0000	620.0000	640.0000	660.0000	680.0000
PH	7.0000	6.8000	7.6000	7.6000	7.5000	6.6000	7.4000	8.5000
ALKALINITY	410.0000	310.0000	150.0000	61.0000	62.0000	260.0000	230.0000	110.0000
CHLORIDE	36.0000	1800.0000	2900.0000	3300.0000	3500.0000	3300.0000	3000.0000	2200.0000
COD	0.0000	90.0000	100.0000	150.0000	1400.0000	170.0000	58.0000	180.0000
COND	1200.0000	6300.0000	9500.0000	9800.0000	10000.0000	10000.0000	11000.0000	9200.0000
TDS	830.0000	5400.0000	6600.0000	7700.0000	8100.0000	7800.0000	7600.0000	6000.0000
TSS	150.0000	170.0000	0.0000	31.0000	100.0000	330.0000	40.0000	180.0000
SULFATE	230.0000	790.0000	1100.0000	1000.0000	980.0000	1300.0000	940.0000	1000.0000
ARSENIC	< .0050	< .0050	< .0050	< .0050	.0200	.0080	.0750	.1200
BORON	.3800	2.2000	28.0000	31.0000	42.0000	48.0000	36.0000	0.0000
CALCIUM	160.0000	1200.0000	2100.0000	1600.0000	2300.0000	3000.0000	2700.0000	2500.0000
LEAD	< .0100	< .0100	.0480	.0320	.0620	.0150	.1200	.1100
MAGNESIUM	44.0000	120.0000	98.0000	72.0000	82.0000	120.0000	81.0000	74.0000
MERCURY	.0019	.0012	.0010	.0018	.0067	.0009	.0009	.0013
SELENIUM	< .0020	< .0020	< .0020	.0120	.0130	.0040	< .0010	.0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	0.0000	0.0000	96.0000	120.0000	71.0000
TOTAL ELEM	470.3989	3912.2182	6226.0560	6003.0508	6904.1017	7864.0279	6877.1969	5845.2333

POND A LEACHATE

WELL DESIG	LWA1	LWA1	LWA1	LWA1	LWA1	LWA1	LWA1	LWA1
DATE	760301.0000	760706.0000	761109.0000	770215.0000	770302.0000	770505.0000	770707.0000	770926.0000
REC NO.	700.0000	720.0000	740.0000	760.0000	780.0000	800.0000	820.0000	840.0000
PH	8.3000	7.4000	7.2000	7.4000	7.4000	7.2000	7.2000	7.3000
ALKALINITY	89.0000	110.0000	58.0000	62.0000	55.0000	41.0000	55.0000	54.0000
CHLORIDE	1800.0000	1200.0000	810.0000	610.0000	860.0000	740.0000	410.0000	320.0000
COD	48.0000	46.0000	47.0000	4.0000	27.0000	23.0000	24.0000	23.0000
COND	7600.0000	3800.0000	3200.0000	3200.0000	3300.0000	3100.0000	2800.0000	3400.0000
TDS	5400.0000	4100.0000	4000.0000	3500.0000	4000.0000	3700.0000	3400.0000	3200.0000
TSS	21.0000	93.0000	910.0000	140.0000	89.0000	59.0000	37.0000	120.0000
SULFATE	1200.0000	1100.0000	2200.0000	2200.0000	1200.0000	1400.0000	1400.0000	1500.0000
ARSENIC	.0600	< .0100	.0120	< .0020	< .0020	.0050	< .0040	< .0040
BORON	46.0000	21.0000	21.0000	53.0000	27.0000	27.0000	20.0000	34.0000
CALCIUM	1500.0000	850.0000	910.0000	730.0000	660.0000	760.0000	770.0000	510.0000
LEAD	.3200	.0190	.0380	.0200	.0130	.0160	.0100	.0140
MAGNESIUM	82.0000	130.0000	91.0000	67.0000	64.0000	62.0000	47.0000	40.0000
MERCURY	.0005	< .0002	< .0002	< .0002	< .0002	< .0002	< .0002	< .0002
SELENIUM	.0060	.0030	.0110	.0080	.0040	.0060	.0110	.0180
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	64.0000	140.0000	81.0000	62.0000	61.0000	44.0000	40.0000	34.0000
TOTAL ELEM	4692.3865	3441.0322	4113.0612	3722.0302	2872.0192	3033.0272	2687.0252	2438.0362

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POND A LEACHATE


WELL DESIG          LWA1         LWA1         LWA1         LWA1
DATE         771108.0000  771216.0000  780316.0000  780511.0000
REC NO.         860.0000     880.0000     900.0000     920.0000
PH                0.0000       7.4000       8.2000       7.4000
ALKALINITY        0.0000      41.0000      32.0000      34.0000
CHLORIDE          0.0000     220.0000      80.0000     120.0000
COD              18.0000      64.0000      13.0000      21.0000
COND              0.0000    2800.0000    2400.0000    2500.0000
TDS               0.0000    2700.0000    2300.0000    2400.0000
TSS               0.0000     460.0000       7.0000      23.0000
SULFATE           0.0000    1400.0000     160.0000    1300.0000
ARSENIC     <      .0040 <      .0020        .0020        .0060
BORON            36.0000      22.0000        .2000       5.0000
CALCIUM         110.0000     770.0000     510.0000     650.0000
LEAD               .0350 <      .0100 <      .0100        .0180
MAGNESIUM        45.0000      35.0000      17.0000      21.0000
MERCURY     <      .0002        .0004 <      .0002        .0023
SELENIUM           .0240        .0100        .0020        .0020
SULFITE           0.0000       0.0000       0.0000       0.0000
SODIUM           34.0000      22.0000      45.0000      11.0000
TOTAL ELEM      225.0642    2469.0224     812.2142    2107.0283
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POND A LEACHATE     --- AEROSPACE ---


WELL DESIG          LWA1         LWA1         LWA1         LWA1         LWA1         LWA1         LWA1         LWA1
DATE         741014.0000  750428.0000  751103.0000  760121.0000  760415.0000  761109.0000  770302.0000  770505.0000
REC NO.         940.0000     960.0000     980.0000    1000.0000    1020.0000    1040.0000    1060.0000    1080.0000
PH                7.8300       7.7100       7.2600       8.1600       7.5900       7.4000       7.4900       6.9500
ALKALINITY       49.0000      67.0000     177.0000      68.0000      60.0000      49.6000      52.0000      38.0000
CHLORIDE        840.0000    2100.0000    3400.0000    2300.0000    1500.0000     710.0000     770.0000     780.0000
COD             110.0000       0.0000     200.0000     150.0000       0.0000       0.0000       0.0000       0.0000
COND           3300.0000    9800.0000    9090.0000    6250.0000    5000.0000    4080.0000    4080.0000    3770.0000
TDS            2460.0000    7292.0000    7560.0000    5860.0000    4340.0000    3596.0000    3362.0000    3138.0000
TSS             870.0000       0.0000       0.0000       0.0000       0.0000       0.0000       0.0000       0.0000
SULFATE         700.0000    1425.0000    1250.0000    1300.0000    1200.0000    1420.0000    1350.0000    1300.0000
ARSENIC           0.0000        .0050        .0040        .0590 <      .0010        .0020        .0010 <      .0010
BORON            10.2000      25.0000      47.0000      45.0000      40.0000      38.0000      32.0000      25.0000
CALCIUM         465.0000    2040.0000    2080.0000    1400.0000    1000.0000     930.0000     920.0000     860.0000
LEAD               .0270        .4400       0.0000 <      .0100        .0100        .0400        .0200        .2800
MAGNESIUM        49.3000      14.8000     129.0000      90.0000      53.0000      81.0000      68.0000      50.0000
MERCURY           0.0000        .0003        .0003 <      .0001        .0009 <      .0001 <      .0001 <      .0001
SELENIUM          0.0000        .0080        .0080        .0140        .0330        .0040 <      .0006 <      .0006
SULFITE           8.6000       0.0000        .4000       0.0000       0.0000       0.0000       0.0000       0.0000
SODIUM            0.0000       0.0000      12.5000      66.0000      50.0000      82.0000      60.0000      48.0000
TOTAL ELEM     2073.1270    5605.2533    6918.9123    5201.0831    3843.0449    3261.0461    3200.0217    3063.2817
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POND A LEACHATE      --- AEROSPACE ---

WELL DESIG         LWA1          LWA1
DATE        780309.0000 780316.0000
REC NO.       1100.0000   1120.0000
PH               7.3000      7.4500
ALKALINITY      24.8000     25.0000
CHLORIDE       195.0000    110.0000
COD              0.0000      0.0000
COND          2110.0000   2140.0000
TDS           2166.0000   2352.0000
TSS              0.0000      0.0000
SULFATE       1312.0000   1375.0000
ARSENIC           .0370      0.0000
BORON           12.5000     11.6000
CALCIUM        470.0000    490.0000
LEAD              .2300      0.0000
MAGNESIUM       24.0000     24.0000
MERCURY           .0011      0.0000
SELENIUM          .0003      0.0000
SULFITE          0.0000      0.0000
SODIUM          10.0000     11.0000
TOTAL ELEM    2023.7684   2021.6000
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POND A GROUND WELL 1

WELL DESIG	GWA1	GWA1	GWA1	GWA1	GWA1	GWA1	GWA1	GWA1
DATE	740709.0000	740722.0000	740729.0000	740805.0000	740903.0000	741007.0000	741028.0000	741209.0000
REC NO.	1140.0000	1160.0000	1180.0000	1200.0000	1220.0000	1240.0000	1260.0000	1280.0000
PH	6.9000	6.9000	6.8000	6.8000	6.9000	7.2000	7.0000	6.5000
ALKALINITY	390.0000	410.0000	410.0000	430.0000	370.0000	380.0000	390.0000	440.0000
CHLORIDE	31.0000	34.0000	34.0000	36.0000	35.0000	37.0000	30.0000	45.0000
COD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	16.0000
COND	1100.0000	390.0000	1100.0000	0.0000	0.0000	0.0000	1200.0000	1100.0000
TDS	730.0000	770.0000	880.0000	840.0000	790.0000	820.0000	770.0000	700.0000
TSS	10.0000	40.0000	35.0000	230.0000	0.0000	83.0000	49.0000	0.0000
SULFATE	140.0000	240.0000	240.0000	280.0000	210.0000	260.0000	180.0000	110.0000
ARSENIC	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050
BORON	.2200	.2900	.3500	.3700	0.0000	.3200	.2500	.4800
CALCIUM	120.0000	130.0000	180.0000	190.0000	160.0000	160.0000	120.0000	110.0000
LEAD	.2400	.0580	.0950	.0680	0.0000	< .0100	< .0100	< .0100
MAGNESIUM	6.8000	42.0000	47.0000	56.0000	48.0000	49.0000	41.0000	32.0000
MERCURY	< .0002	.0010	0.0000	.0013	< .0002	< .0003	.0002	.0004
SELENIUM	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL ELEM	298.2672	446.3560	501.4520	562.4463	453.0072	506.3373	371.2672	297.4974

POND A GROUND WELL 1

WELL DESIG	GWA1	GWA1	GWA1	GWA1	GWA1	GWA1	GWA1	GWA1
DATE	750211.0000	750428.0000	750707.0000	750901.0000	751103.0000	760106.0000	760301.0000	770505.0000
REC NO.	1300.0000	1320.0000	1340.0000	1360.0000	1380.0000	1400.0000	1420.0000	1440.0000
PH	6.7000	6.9000	6.5000	6.8000	7.3000	6.5000	6.6000	6.2000
ALKALINITY	380.0000	210.0000	300.0000	280.0000	200.0000	350.0000	250.0000	42.0000
CHLORIDE	25.0000	94.0000	36.0000	41.0000	46.0000	40.0000	33.0000	38.0000
COD	66.0000	19.0000	34.0000	17.0000	27.0000	0.0000	0.0000	10.0000
COND	1000.0000	930.0000	980.0000	960.0000	1000.0000	730.0000	740.0000	380.0000
TDS	670.0000	700.0000	650.0000	690.0000	670.0000	540.0000	420.0000	250.0000
TSS	0.0000	81.0000	420.0000	21.0000	20.0000	310.0000	170.0000	24.0000
SULFATE	140.0000	150.0000	150.0000	150.0000	160.0000	130.0000	140.0000	72.0000
ARSENIC	< .0050	< .0050	.0050	< .0050	< .0050	< .0050	.0300	< .0020
BORON	.3800	.4900	.4600	1.3000	.3700	0.0000	.3600	.5400
CALCIUM	150.0000	160.0000	110.0000	130.0000	94.0000	120.0000	98.0000	22.0000
LEAD	.0400	.0400	.0450	.0180	.0160	.0370	< .0100	.0170
MAGNESIUM	36.0000	36.0000	36.0000	38.0000	48.0000	32.0000	31.0000	7.3000
MERCURY	.0035	.0028	.0170	.0013	.0013	.0007	.0016	< .0002
SELENIUM	< .0020	< .0020	< .0020	< .0020	< .0010	< .0020	< .0040	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	64.0000	68.0000	68.0000	62.0000	56.0000	1.6000
TOTAL ELEM	351.4305	440.5398	396.5290	428.3263	416.3933	384.0447	358.4056	141.4612

POND A GROUND WELL 1

WELL DESIG	GWA1	GWA1	GWA1	GWA1
DATE	771216.0000	780316.0000	780511.0000	780628.0000
REC NO.	1460.0000	1480.0000	1500.0000	1520.0000
PH	6.8000	6.5000	6.9000	7.9000
ALKALINITY	100.0000	96.0000	130.0000	230.0000
CHLORIDE	140.0000	150.0000	92.0000	73.0000
COD	46.0000	19.0000	4.0000	6.0000
COND	680.0000	740.0000	630.0000	670.0000
TDS	700.0000	450.0000	400.0000	880.0000
TSS	17000.0000	52.0000	150.0000	11000.0000
SULFATE	30.0000	18.0000	27.0000	1.0000
ARSENIC	.0130	< .0020	< .0040	< .0040
BORON	.1000	2.2000	.1000	.1400
CALCIUM	78.0000	25.0000	37.0000	37.0000
LEAD	.0850	.0740	.0150	.1000
MAGNESIUM	34.0000	7.6000	14.0000	14.0000
MERCURY	.0005	< .0002	.0005	.0012
SELENIUM	< .0020	< .0020	.0010	< .0010
SULFITE	0.0000	0.0000	0.0000	0.0000
SODIUM	84.0000	49.0000	76.0000	100.0000
TOTAL ELEM	366.2005	251.8782	246.1205	225.2462

POND A GROUND WELL 1--- AEROSPACE ---

WELL DESIG	GWA1	GWA1	GWA1	GWA1	GWA1	GWA1	GWA1	GWA1
DATE	740904.0000	741028.0000	750415.0000	750428.0000	751103.0000	770505.0000	780309.0000	780316.0000
REC NO.	1540.0000	1560.0000	1580.0000	1600.0000	1620.0000	1640.0000	1660.0000	1680.0000
PH	8.1800	7.9400	7.1200	6.9300	7.5000	6.7200	7.6200	8.0100
ALKALINITY	179.0000	0.0000	250.0000	286.0000	314.0000	36.0000	84.0000	80.0000
CHLORIDE	84.0000	86.0000	86.0000	86.0000	100.0000	74.0000	230.0000	260.0000
COD	40.0000	0.0000	0.0000	95.0000	40.0000	0.0000	0.0000	0.0000
COND	910.0000	860.0000	690.0000	910.0000	820.0000	340.0000	595.0000	617.0000
TDS	620.0000	589.0000	480.0000	440.0000	740.0000	240.0000	338.0000	370.0000
TSS	0.0000	130.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SULFATE	8.0000	175.0000	120.0000	250.0000	150.0000	73.0000	21.0000	14.0000
ARSENIC	.0050	.0040	.0310	.0050	.0060	.0040	.0080	0.0000
BORON	.4000	.4000	1.8000	.3000	.5000	.5000	1.2000	< .5000
CALCIUM	40.0000	40.0000	57.0000	68.0000	72.0000	19.0000	35.0000	36.0000
LEAD	.0500	.0530	.0100	.0700	< .0200	.1000	.1200	0.0000
MAGNESIUM	72.0000	34.2000	31.0000	33.0000	40.0000	6.0000	17.0000	18.0000
MERCURY	.0008	0.0000	.0008	.0005	.0006	< .0001	.0012	0.0000
SELENIUM	.0040	.0020	.0130	.0150	.0080	< .0006	.0006	0.0000
SULFITE	.4000	.1000	0.0000	.5000	.3000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	60.0000	0.0000	78.0000	40.0000	60.0000	60.0000
TOTAL ELEM	204.8598	335.7590	355.8548	437.8905	440.8346	212.6047	364.3298	388.5000

POND A GROUND WELL 2

WELL DESIG	GWA2	GWA2	GWA2	GWA2	GWA2	GWA2	GWA2	GWA2
DATE	740722.0000	740729.0000	740805.0000	740903.0000	741007.0000	741022.0000	741028.0000	741209.0000
REC NO.	1700.0000	1720.0000	1740.0000	1760.0000	1780.0000	1800.0000	1820.0000	1840.0000
PH	7.3000	7.1000	7.2000	7.2000	7.3000	7.7000	7.7000	8.0000
ALKALINITY	670.0000	640.0000	590.0000	570.0000	490.0000	400.0000	480.0000	400.0000
CHLORIDE	27.0000	26.0000	26.0000	27.0000	26.0000	24.0000	22.0000	30.0000
COD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	16.0000
COND	1100.0000	870.0000	0.0000	0.0000	0.0000	990.0000	970.0000	850.0000
TDS	790.0000	750.0000	720.0000	680.0000	610.0000	610.0000	580.0000	550.0000
TSS	100.0000	39.0000	31.0000	0.0000	62.0000	43.0000	110.0000	18.0000
SULFATE	22.0000	32.0000	28.0000	21.0000	42.0000	40.0000	46.0000	64.0000
ARSENIC	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050
BORON	.1400	.1600	.1600	.1200	.1200	.1000	.1000	.2300
CALCIUM	100.0000	120.0000	120.0000	100.0000	94.0000	100.0000	63.0000	59.0000
LEAD	.0850	.0520	.0890	.0140	< .0100	< .0100	< .0100	< .0100
MAGNESIUM	65.0000	66.0000	63.0000	54.0000	51.0000	52.0000	46.0000	38.0000
MERCURY	< .0002	0.0000	.0015	< .0002	< .0002	.0004	< .0002	< .0002
SELENIUM	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL ELEM	214.2322	244.2190	237.2575	202.1412	213.1372	216.1174	177.1172	191.2472

POND A GROUND WELL 2

WELL DESIG	GWA2	GWA2	GWA2	GWA2	GWA2	GWA2	GWA2
DATE	750211.0000	750428.0000	750707.0000	750901.0000	751107.0000	760106.0000	760301.0000
REC NO.	1860.0000	1880.0000	1900.0000	1920.0000	1940.0000	1960.0000	1980.0000
PH	7.4000	7.4000	7.1000	0.0000	7.5000	7.2000	7.0000
ALKALINITY	74.0000	58.0000	100.0000	0.0000	150.0000	110.0000	86.0000
CHLORIDE	18.0000	16.0000	20.0000	0.0000	13.0000	9.0000	8.0000
COD	21.0000	8.0000	47.0000	10.0000	10.0000	11.0000	6.0000
COND	500.0000	420.0000	440.0000	0.0000	470.0000	350.0000	330.0000
TDS	330.0000	320.0000	530.0000	0.0000	350.0000	240.0000	220.0000
TSS	0.0000	89.0000	19000.0000	0.0000	12.0000	50.0000	10.0000
SULFATE	130.0000	88.0000	190.0000	0.0000	88.0000	65.0000	75.0000
ARSENIC	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	.0100
BORON	.2600	.3400	.3300	.8000	.3100	0.0000	.1700
CALCIUM	40.0000	32.0000	110.0000	51.0000	45.0000	38.0000	28.0000
LEAD	.0280	.0160	.2000	.0220	.0170	.0300	.0490
MAGNESIUM	18.0000	12.0000	4.2000	15.0000	26.0000	14.0000	14.0000
MERCURY	.0004	.0011	.0015	.0006	< .0002	.0007	< .0002
SELENIUM	< .0020	< .0020	< .0020	< .0020	< .0010	< .0020	< .0040
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	28.0000	32.0000	30.0000	22.0000	19.0000
TOTAL ELEM	206.2954	148.3641	352.7385	98.8296	202.3332	148.0377	144.2332

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POND A GROUND WELL 2--- AEROSPACE ---

WELL DESIG          GWA2          GWA2          GWA2          GWA2          GWA2
DATE         740904.0000   741028.0000   750428.0000   751103.0000   760415.0000
REC NO.        2000.0000     2020.0000     2040.0000     2060.0000     2080.0000
PH                8.7100        8.7200        7.4000        7.7200        7.4800
ALKALINITY      389.0000      330.0000       55.0000      155.0000       82.0000
CHLORIDE         64.0000       73.0000       43.0000       56.0000       44.0000
COD              20.0000       40.0000        5.0000       40.0000        0.0000
COND            770.0000      690.0000      370.0000      420.0000      290.0000
TDS             488.0000      440.0000      248.0000      344.0000      190.0000
TSS               0.0000        0.0000        0.0000        0.0000        0.0000
SULFATE          22.0000       51.0000      175.0000       90.0000       70.0000
ARSENIC            .0050         .0050         .0050         .0060         .0010
BORON              .4000         .2000         .1000         .1000        1.5000
CALCIUM          15.0000       15.0000       28.0000       32.0000       27.0000
LEAD               .0400         .0300         .0200         .0200         .0100
MAGNESIUM        74.0000       70.0000       13.4000       19.0000       11.0000
MERCURY            .0005        0.0000         .0004         .0002         .0008
SELENIUM           .0050         .0020         .0040         .0020         .0080
SULFITE            .9000         .9000         .2000         .2000        0.0000
SODIUM            0.0000        0.0000        0.0000       33.0000       22.0000
TOTAL ELEM      176.3505      210.1370      259.7294      230.3282      175.5198
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POND B SUPERNATE

WELL DESIG	PSB	PSB	PSB	PSB	PSB	PSB	PSB	PSB
DATE	750415.0000	750428.0000	750708.0000	750901.0000	751103.0000	760106.0000	760301.0000	760503.0000
REC NO.	2100.0000	2120.0000	2140.0000	2160.0000	2180.0000	2200.0000	2220.0000	2240.0000
PH	11.5000	8.7000	8.4000	8.6000	8.3000	7.1000	7.5000	7.4000
ALKALINITY	1300.0000	79.0000	30.0000	47.0000	34.0000	29.0000	30.0000	34.0000
CHLORIDE	1500.0000	600.0000	320.0000	380.0000	320.0000	150.0000	66.0000	82.0000
COD	60.0000	25.0000	25.0000	54.0000	43.0000	8.0000	11.0000	42.0000
COND	8600.0000	2600.0000	2200.0000	3400.0000	2900.0000	1500.0000	900.0000	1800.0000
TDS	5600.0000	2200.0000	1800.0000	3000.0000	2800.0000	880.0000	770.0000	1800.0000
TSS	160.0000	8.0000	4.0000	17.0000	17.0000	11.0000	2.0000	15.0000
SULFATE	960.0000	430.0000	900.0000	1700.0000	1200.0000	94.0000	460.0000	950.0000
ARSENIC	< .0050	< .0050	.0100	.0050	.0200	.0050	< .0100	.0200
BORON	63.0000	24.0000	10.0000	7.5000	.5700	0.0000	.9400	2.1000
CALCIUM	2300.0000	840.0000	510.0000	980.0000	580.0000	320.0000	270.0000	370.0000
LEAD	< .0100	.0400	< .0100	.0250	< .0100	< .0100	.0100	.0100
MAGNESIUM	.2000	4.2000	2.8000	3.2000	6.9000	3.9000	2.7000	4.8000
MERCURY	.0002	< .0002	.0003	< .0002	< .0002	< .0002	< .0002	< .0002
SELENIUM	.0900	< .0020	.0050	.0030	< .0010	< .0020	.0040	< .0040
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	21.0000	40.0000	30.0000	9.3000	6.7000	15.0000
TOTAL ELEM	4823.3052	1898.2472	1763.8253	3110.7332	2137.5012	577.2172	806.3642	1423.9342

POND B SUPERNATE

WELL DESIG	PSB	PSB	PSB	PSB	PSB	PSB	PSB	PSB
DATE	760706.0000	770302.0000	770504.0000	770707.0000	770926.0000	771104.0000	771216.0000	780316.0000
REC NO.	2260.0000	2280.0000	2300.0000	2320.0000	2340.0000	2360.0000	2380.0000	2400.0000
PH	7.1000	7.4000	6.9000	7.0000	7.2000	7.2000	7.0000	7.3000
ALKALINITY	36.0000	43.0000	35.0000	40.0000	34.0000	36.0000	28.0000	28.0000
CHLORIDE	23.0000	62.0000	32.0000	56.0000	48.0000	58.0000	17.0000	8.0000
COD	25.0000	21.0000	19.0000	43.0000	44.0000	30.0000	10.0000	8.0000
COND	700.0000	1500.0000	1100.0000	1600.0000	1600.0000	2400.0000	790.0000	590.0000
TDS	460.0000	1600.0000	1200.0000	1900.0000	1400.0000	2300.0000	560.0000	430.0000
TSS	4.0000	5.0000	6.0000	10.0000	8.0000	9.0000	6.0000	5.0000
SULFATE	330.0000	1100.0000	810.0000	1300.0000	750.0000	1500.0000	350.0000	64.0000
ARSENIC	< .0050	.0120	.0240	.0350	.0500	.0060	< .0020	.0040
BORON	1.0000	.8000	2.2000	3.4000	2.2000	3.5000	.5400	.1300
CALCIUM	160.0000	450.0000	370.0000	500.0000	410.0000	960.0000	200.0000	100.0000
LEAD	< .0100	0.0000	< .0100	< .0100	< .0100	< .0100	.0100	< .0100
MAGNESIUM	2.1000	6.3000	4.2000	3.3000	3.3000	4.8000	2.3000	1.6000
MERCURY	< .0002	< .0002	.0006	.0002	.0016	< .0002	< .0002	< .0002
SELENIUM	.0010	.0040	< .0040	.0040	< .0020	.0020	< .0020	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	5.1000	12.0000	7.0000	10.0000	8.9000	12.0000	4.4000	2.5000
TOTAL ELEM	521.2162	1631.1162	1225.4386	1872.7492	1222.4636	2538.3182	574.2542	176.2462

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POND B SUPERNATE

WELL DESIG         PSB
DATE        780511.0000
REC NO.       2420.0000
PH               7.2000
ALKALINITY      38.0000
CHLORIDE        14.0000
COD             19.0000
COND          1600.0000
TDS           1400.0000
TSS              6.0000
SULFATE        800.0000
ARSENIC           .0170
BORON             .8000
CALCIUM        410.0000
LEAD              .0150
MAGNESIUM        3.8000
MERCURY    <      .0002
SELENIUM          .0010
SULFITE          0.0000
SODIUM           3.8000
TOTAL ELEM    1232.4332
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POND B SUPERNATE    --- AEROSPACE ---

WELL DESIG         PSB          PSB          PSB          PSB          PSB          PSB
DATE        750415.0000  751103.0000  760503.0000  760518.0000  770504.0000  780309.0000
REC NO.       2440.0000    2460.0000    2480.0000    2500.0000    2520.0000    2540.0000
PH              12.1500       6.7900       6.7000       7.3500       6.9900       7.8000
ALKALINITY    1294.0000      35.0000      34.0000      30.0000      31.0000      16.0000
CHLORIDE      2400.0000     400.0000     117.0000     130.0000     126.0000       3.5000
COD              0.0000      50.0000       0.0000       0.0000       0.0000       0.0000
COND          7900.0000    2700.0000    1810.0000    1420.0000    1230.0000     110.0000
TDS           5560.0000    2670.0000    1780.0000    1460.0000    1098.0000     102.0000
TSS              0.0000       0.0000       0.0000       0.0000       0.0000       0.0000
SULFATE       1875.0000    1500.0000    1100.0000     775.0000     775.0000      24.0000
ARSENIC           .0040        .0100        .0120        .0010        .0060  <     .0040
BORON           86.0000       4.4000       3.0000       1.8000        .9500  <     .5000
CALCIUM       1740.0000     580.0000     400.0000     300.0000     340.0000      18.0000
LEAD              .3900  <     .0100  <     .0100        .0100        .0250        .2000
MAGNESIUM        0.0000      10.0000       5.0000       4.0000       3.2000       1.5000
MERCURY           .0001        .0004        .0006        .0012  <     .0001        .0007
SELENIUM          .0890        .0180        .0650        .0360        .0013        .0003
SULFITE         70.0000        .2000       0.0000       0.0000       0.0000       0.0000
SODIUM          34.0000      28.0000      15.0000      11.0000       7.2000       1.5000
TOTAL ELEM    6205.4831    2522.6384    1640.0876    1221.8482    1252.3824      49.2050
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POND B LEACHATE

WELL DESIG          LWB          LWB          LWB          LWB          LWB          LWB          LWB          LWB
DATE        750211.0000  750415.0000  750422.0000  750428.0000  750707.0000  750901.0000  751103.0000  760106.0000
REC NO.       2560.0000    2580.0000    2600.0000    2620.0000    2640.0000    2660.0000    2680.0000    2700.0000
PH               8.3000       0.0000       6.0000       6.9000      10.1000       9.1000       6.2000       7.3000
ALKALINITY     350.0000       0.0000       8.0000      22.0000     250.0000      70.0000       8.0000      39.0000
CHLORIDE       110.0000       0.0000     620.0000     460.0000     940.0000     880.0000     860.0000     630.0000
COD             48.0000      14.0000      92.0000      42.0000    1200.0000      98.0000      35.0000      13.0000
COND          1200.0000       0.0000       0.0000       0.0000    3400.0000    3900.0000    3700.0000    3100.0000
TDS            440.0000       0.0000       0.0000    1800.0000    2600.0000    2500.0000    2600.0000    2700.0000
TSS              0.0000       0.0000       0.0000      18.0000   12000.0000    2600.0000       6.0000     130.0000
SULFATE         85.0000       0.0000     440.0000     530.0000     490.0000     360.0000     620.0000     890.0000
ARSENIC           .0070        .0050        .0100        .0500        .0400        .0200        .0250        .0150
BORON             .9600  <     .1000      50.0000       0.0000       3.2000        .9000        .2600       0.0000
CALCIUM         64.0000     290.0000     470.0000     530.0000    2300.0000     570.0000     620.0000     840.0000
LEAD              .0580        .0900        .0240        .0280        .0490        .0160  <     .0100        .0470
MAGNESIUM        6.8000      44.0000      36.0000      35.0000      57.0000       2.6000      27.0000      25.0000
MERCURY     <     .0002        .0016  <     .0002        .0038        .0007        .0014  <     .0002        .0005
SELENIUM    <     .0020        .0100        .0620        .1300        .2000        .0230        .0040        .0040
SULFITE          0.0000       0.0000       0.0000       0.0000       0.0000       0.0000       0.0000       0.0000
SODIUM           0.0000       0.0000       0.0000       0.0000      70.0000     160.0000     150.0000     110.0000
TOTAL ELEM     266.8272     334.2066    1616.0962    1555.2118    3860.4897    1973.5604    2277.2992    2495.0665


POND B LEACHATE

WELL DESIG          LWB          LWB
DATE        760301.0000  760503.0000
REC NO.       2720.0000    2740.0000
PH               7.0000       7.9000
ALKALINITY      34.0000     120.0000
CHLORIDE       290.0000     130.0000
COD             12.0000      43.0000
COND          2600.0000    1600.0000
TDS           2400.0000    1400.0000
TSS             49.0000     530.0000
SULFATE       1200.0000     980.0000
ARSENIC           .0200        .0100
BORON             .9600       1.1000
CALCIUM        790.0000     380.0000
LEAD              .0580  <     .0100
MAGNESIUM       14.0000       7.7000
MERCURY     <     .0002  <     .0002
SELENIUM    <     .0040  <     .0040
SULFITE          0.0000       0.0000
SODIUM          68.0000      19.0000
TOTAL ELEM    2363.0422    1517.8242
```

POND B LEACHATE --- AEROSPACE ---

WELL DESIG	LWB	LWB	LWB	LWB	LWB
DATE	750211.0000	750415.0000	751103.0000	760121.0000	760503.0000
REC NO.	2760.0000	2780.0000	2800.0000	2820.0000	2840.0000
PH	5.3200	6.7300	6.1800	7.3700	7.0700
ALKALINITY	0.0000	28.0000	10.0000	2.0000	0.0000
CHLORIDE	170.0000	140.0000	1100.0000	520.0000	139.0000
COD	75.0000	0.0000	50.0000	50.0000	0.0000
COND	880.0000	300.0000	3570.0000	2700.0000	1790.0000
TDS	500.0000	320.0000	2670.0000	2540.0000	1690.0000
TSS	0.0000	0.0000	0.0000	0.0000	0.0000
SULFATE	150.0000	150.0000	675.0000	1100.0000	1000.0000
ARSENIC	.0140	.0050	.0040	.0110	0.0000
BORON	.1000	1.0000	1.0000	1.3000	3.8000
CALCIUM	20.0000	28.0000	400.0000	525.0000	450.0000
LEAD	.0400	.0200	< .0100	.0100	< .0100
MAGNESIUM	8.0000	8.0000	26.0000	27.0000	11.0000
MERCURY	.0010	.0004	.0002	.0007	0.0000
SELENIUM	.0170	.0080	.0160	.0090	0.0000
SULFITE	.1700	.1000	.1000	0.0000	0.0000
SODIUM	0.0000	0.0000	158.0000	83.0000	23.0000
TOTAL ELEM	348.3420	327.1334	2360.1302	2256.3307	1626.8100

POND B LEACHATE 1

WELL DESIG	LWB1	LWB1	LWB1	LWB1	LWB1	LWB1	LWB1	LWB1
DATE	760706.0000	760720.0000	770302.0000	770504.0000	770707.0000	770926.0000	771104.0000	771216.0000
REC NO.	2860.0000	2880.0000	2900.0000	2920.0000	2940.0000	2960.0000	2980.0000	3000.0000
PH	7.5000	7.3000	6.6000	6.5000	7.1000	7.0000	6.2000	6.4000
ALKALINITY	84.0000	66.0000	24.0000	34.0000	28.0000	30.0000	12.0000	18.0000
CHLORIDE	930.0000	130.0000	340.0000	440.0000	420.0000	370.0000	300.0000	290.0000
COD	64.0000	63.0000	42.0000	36.0000	15.0000	29.0000	15.0000	17.0000
COND	2500.0000	1800.0000	2600.0000	2800.0000	2700.0000	3400.0000	3100.0000	2900.0000
TDS	2500.0000	1900.0000	3100.0000	3200.0000	3200.0000	3100.0000	2800.0000	2900.0000
TSS	870.0000	200.0000	11.0000	30.0000	10.0000	8.0000	9.0000	36.0000
SULFATE	750.0000	1200.0000	1600.0000	1700.0000	1600.0000	1600.0000	1500.0000	1500.0000
ARSENIC	.0800	.0200	.0020	.0140	.0090	.0110	.0040	.0020
BORON	1.9000	2.2000	.3700	2.7000	2.4000	2.6000	2.0000	1.2000
CALCIUM	630.0000	620.0000	570.0000	690.0000	720.0000	710.0000	890.0000	790.0000
LEAD	.0290	< .0100	< .0100	.0160	< .0100	.0100	< .0100	< .0100
MAGNESIUM	27.0000	8.4000	19.0000	20.0000	19.0000	19.0000	16.0000	18.0000
MERCURY	< .0002	.0002	< .0002	.0008	< .0002	.0002	< .0002	.0002
SELENIUM	.0080	< .0010	.0050	.0060	.0100	.0020	< .0010	.0100
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	23.0000	23.0000	82.0000	84.0000	71.0000	90.0000	78.0000	82.0000
TOTAL ELEM	2362.0172	1983.6312	2611.3872	2936.7368	2832.4292	2791.6232	2786.0152	2681.2222

POND B LEACHATE 1

WELL DESIG	LWB1	LWB1
DATE	780316.0000	780511.0000
REC NO.	3020.0000	3040.0000
PH	7.6000	7.2000
ALKALINITY	70.0000	30.0000
CHLORIDE	88.0000	86.0000
COD	7.0000	42.0000
COND	2100.0000	2200.0000
TDS	1900.0000	1900.0000
TSS	250.0000	8.0000
SULFATE	890.0000	940.0000
ARSENIC	.0040	.0190
BORON	.3000	4.0000
CALCIUM	820.0000	500.0000
LEAD	< .0100	.0100
MAGNESIUM	8.6000	7.1000
MERCURY	< .0002	.0008
SELENIUM	.0020	.0020
SULFITE	0.0000	0.0000
SODIUM	31.0000	22.0000
TOTAL ELEM	1837.9162	1559.1318

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POND B LEACHATE 1   --- AEROSPACE ---

WELL DESIG          LWB1         LWB1         LWB1         LWB1
DATE         770203.0000  770405.0000  780309.0000  780316.0000
REC NO.        3060.0000    3080.0000    3100.0000    3120.0000
PH                6.9300       6.6600       7.3000       7.2100
ALKALINITY       18.0000      19.0000      20.2000      18.0000
CHLORIDE        380.0000     460.0000     300.0000     150.0000
COD               0.0000       0.0000       0.0000       0.0000
COND           3080.0000    3150.0000    2310.0000    2290.0000
TDS            2882.0000    2912.0000    2324.0000    2380.0000
TSS               0.0000       0.0000       0.0000       0.0000
SULFATE        1725.0000    1475.0000    1325.0000    1400.0000
ARSENIC            .0020  <     .0010        .0780       0.0000
BORON             2.6000       1.3000       1.0000       1.0000
CALCIUM         670.0000     710.0000     480.0000     490.0000
LEAD               .0400        .2600        .2700       0.0000
MAGNESIUM        21.0000      18.5000      12.0000      14.0000
MERCURY     <      .0001  <     .0001  <     .0001       0.0000
SELENIUM           .0013  <     .0006        .0001       0.0000
SULFITE           0.0000       0.0000       0.0000       0.0000
SODIUM           86.0000      82.0000      35.0000      30.0000
TOTAL ELEM     2884.6434    2747.0617    2153.3482    2085.0000
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POND B LEACHATE 2

WELL DESIG          LWB2          LWB2          LWB2          LWB2          LWB2          LWB2          LWB2          LWB2
DATE         760720.0000   770504.0000   770707.0000   770926.0000   771104.0000   771216.0000   780316.0000   780511.0000
REC NO.        3140.0000     3160.0000     3180.0000     3200.0000     3220.0000     3240.0000     3260.0000     3280.0000
PH                7.4000        6.7000        6.7000        3.6000        3.7000        4.4000        5.5000        4.4000
ALKALINITY       92.0000       79.0000       28.0000        0.0000        0.0000        0.0000        4.0000        0.0000
CHLORIDE        660.0000      220.0000      500.0000      300.0000      360.0000      280.0000      240.0000      240.0000
COD              60.0000       37.0000       73.0000      100.0000       64.0000       66.0000       64.0000       16.0000
COND           2800.0000     2400.0000     2900.0000     3400.0000     3400.0000     2800.0000     2900.0000     3000.0000
TDS            2800.0000     2800.0000     3400.0000     3100.0000     2900.0000     2600.0000     2600.0000     2700.0000
TSS             690.0000      140.0000      700.0000      150.0000       55.0000      120.0000      110.0000       46.0000
SULFATE         970.0000     1300.0000     1900.0000     1600.0000     1600.0000     1400.0000      980.0000     1500.0000
ARSENIC            .0200         .0940         .0940         .0170         .0060         .0060         .0090         .0400
BORON             2.1000        3.8000        2.5000        1.7000         .6400         .9000        8.0000        1.0000
CALCIUM         800.0000      680.0000      640.0000      530.0000      790.0000      730.0000      620.0000      690.0000
LEAD               .0180  <      .0100  <      .0100         .0190  <      .0100         .0780  <      .0100         .0100
MAGNESIUM        26.0000       18.0000       15.0000        5.2000        2.5000        4.2000       11.0000        7.3000
MERCURY            .0005  <      .0002         .0004  <      .0007  <      .0002  <      .0002  <      .0002         .0009
SELENIUM           .0020         .0060         .0200         .0150         .0130  <      .0020         .0040         .0050
SULFITE           0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000
SODIUM          110.0000       44.0000      100.0000       89.0000       81.0000       69.0000       42.0000       47.0000
TOTAL ELEM     2568.1405     2265.9102     3157.6244     2525.9517     2834.1692     2484.1862     1901.0232     2485.3559
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POND B LEACHATE 2   --- AEROSPACE ---

WELL DESIG          LWB2          LWB2          LWB2          LWB2
DATE         770302.0000   770504.0000   780309.0000   780316.0000
REC NO.        3300.0000     3320.0000     3340.0000     3360.0000
PH                2.9100        6.7400        4.5700        4.3500
ALKALINITY        0.0000       72.0000        0.0000        0.0000
CHLORIDE        310.0000      275.0000      500.0000      340.0000
COD               0.0000        0.0000        0.0000        0.0000
COND           2880.0000     2650.0000     2570.0000     2590.0000
TDS            2638.0000     2614.0000     2416.0000     2516.0000
TSS               0.0000        0.0000        0.0000        0.0000
SULFATE        1550.0000     1650.0000     1300.0000     1325.0000
ARSENIC            .0140         .0010         .0300        0.0000
BORON             2.5000        1.9500        2.1000        1.6000
CALCIUM         610.0000      700.0000      500.0000      550.0000
LEAD               .0550         .2500         .2300        0.0000
MAGNESIUM        12.0000       12.6000       10.0000        6.8000
MERCURY            .0001  <      .0001         .0010        0.0000
SELENIUM           .0020         .0017         .0004        0.0000
SULFITE           0.0000        0.0000        0.0000        0.0000
SODIUM           60.0000       45.0000       50.0000       48.0000
TOTAL ELEM     2544.5711     2684.8028     2362.3614     2271.4000
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POND B GROUND WELL 1

WELL DESIG	GWB1	GWB1	GWB1	GWB1	GWB1	GWB1	GWB1	GWB1
DATE	750415.0000	750422.0000	750428.0000	750708.0000	750901.0000	751103.0000	760106.0000	760301.0000
REC NO.	3380.0000	3400.0000	3420.0000	3440.0000	3460.0000	3480.0000	3500.0000	3520.0000
PH	6.9000	6.9000	6.9000	6.9000	6.7000	6.9000	6.7000	6.8000
ALKALINITY	240.0000	240.0000	240.0000	240.0000	210.0000	190.0000	170.0000	170.0000
CHLORIDE	68.0000	64.0000	66.0000	82.0000	66.0000	91.0000	170.0000	140.0000
COD	0.0000	40.0000	210.0000	1400.0000	18.0000	6.0000	16.0000	9.0000
COND	610.0000	0.0000	720.0000	690.0000	660.0000	650.0000	910.0000	840.0000
TDS	420.0000	490.0000	300.0000	510.0000	530.0000	0.0000	500.0000	520.0000
TSS	120.0000	19.0000	23.0000	1000.0000	450.0000	130.0000	4200.0000	250.0000
SULFATE	24.0000	28.0000	23.0000	24.0000	42.0000	42.0000	68.0000	42.0000
ARSENIC	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	.0100
BORON	.1300	.1400	.1300	.1400	.7000	.2600	.2400	.0200
CALCIUM	31.0000	43.0000	0.0000	0.0000	61.0000	35.0000	100.0000	72.0000
LEAD	.1800	.0560	0.0000	0.0000	.0720	.1800	.5800	.0270
MAGNESIUM	15.0000	16.0000	0.0000	0.0000	15.0000	15.0000	27.0000	18.0000
MERCURY	.0059	.0007	.0008	.0005	< .0002	< .0002	< .0002	< .0002
SELENIUM	< .0020	< .0020	< .0020	< .0020	< .0020	.0120	< .0020	.0040
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	0.0000	89.0000	0.0000	95.0000	130.0000
TOTAL ELEM	138.3229	151.2037	89.1378	106.1475	273.7792	183.4572	460.8272	402.0612

POND B GROUND WELL 1

WELL DESIG	GWB1	GWB1	GWB1	GWB1	GWB1	GWB1	GWB1	GWB1
DATE	760503.0000	760712.0000	760914.0000	761109.0000	770504.0000	770707.0000	771216.0000	780316.0000
REC NO.	3540.0000	3560.0000	3580.0000	3600.0000	3620.0000	3640.0000	3660.0000	3680.0000
PH	7.1000	7.3000	7.1000	6.9000	6.9000	7.0000	7.2000	7.0000
ALKALINITY	190.0000	200.0000	200.0000	180.0000	180.0000	170.0000	220.0000	75.0000
CHLORIDE	88.0000	93.0000	150.0000	160.0000	100.0000	180.0000	120.0000	96.0000
COD	23.0000	11.0000	10.0000	18.0000	4.0000	16.0000	26.0000	54.0000
COND	740.0000	700.0000	770.0000	790.0000	680.0000	870.0000	1000.0000	770.0000
TDS	450.0000	460.0000	550.0000	630.0000	460.0000	600.0000	690.0000	470.0000
TSS	2500.0000	270.0000	1100.0000	820.0000	200.0000	1500.0000	11000.0000	220.0000
SULFATE	120.0000	22.0000	36.0000	82.0000	60.0000	79.0000	84.0000	39.0000
ARSENIC	< .0050	< .0050	< .0050	.0120	.0280	.1500	.0090	< .0020
BORON	.1000	.8000	.1600	.1600	1.8000	.2200	.7700	.3000
CALCIUM	55.0000	41.0000	45.0000	42.0000	53.0000	33.0000	69.0000	300.0000
LEAD	.1100	.3600	.0840	.0290	.0400	< .0100	< .0100	.0350
MAGNESIUM	14.0000	16.0000	16.0000	19.0000	12.0000	21.0000	4.2000	16.0000
MERCURY	< .0002	.0003	< .0002	.0013	.0005	.0011	.0032	< .0002
SELENIUM	.0040	.0030	.0040	.0040	< .0040	.0040	< .0020	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	74.0000	97.0000	11.0000	140.0000	100.0000	160.0000	160.0000	2.3000
TOTAL ELEM	351.2192	270.1683	258.2532	443.2063	326.8725	473.3851	437.9942	453.6392

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POND B GROUND WELL 1


WELL DESIG         GWB1        GWB1
DATE        780511.0000 780628.0000
PEC NO.       3700.0000   3720.0000
PH               7.2000      7.8000
ALKALINITY     170.0000    170.0000
CHLORIDE        84.0000     72.0000
COD             13.0000      9.0000
COND           690.0000    750.0000
TDS            540.0000    410.0000
TSS            620.0000    340.0000
SULFATE         56.0000    310.0000
ARSENIC           .0390 <     .0040
BOPON             .0600       .3800
CALCIUM         54.0000     47.0000
LEAD              .1100       .0310
MAGNESIUM       14.0000     14.0000
MEPCURY           .0019       .0016
SELENIUM          .0040       .0020
SULFITE          0.0000      0.0000
SODIUM          65.0000     82.0000
TOTAL ELEM     273.2149    525.4186


POND B GROUND WELL 1--- AEROSPACE ---


WELL DESIG         GWB1        GWB1        GWB1        GWB1        GWB1        GWB1        GWB1
DATE        750415.0000 751103.0000 760503.0000 761109.0000 770504.0000 780309.0000 780316.0000
REC NO.       3740.0000   3760.0000   3780.0000   3800.0000   3820.0000   3840.0000   3860.0000
PH               7.6300      7.0600      7.9300      7.8200      7.0400      7.9700      8.1200
ALKALINITY     217.0000    189.0000    173.0000    187.0000    179.0000    196.0000    171.0000
CHLORIDE        95.0000    130.0000     88.0000    175.0000    150.0000    300.0000    290.0000
COD             75.0000     40.0000      0.0000      0.0000      0.0000      0.0000      0.0000
COND           620.0000    610.0000    680.0000    880.0000    630.0000    813.0000    833.0000
TDS            400.0000    392.0000    354.0000    534.0000    430.0000    564.0000    546.0000
TSS              0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SULFATE        225.0000     15.0000     60.0000     46.0000     44.0000     80.0000     90.0000
APSENIC           .0050       .0060       .0050       .0120       .0040       .0080      0.0000
BOPON             .9000 <     .1000       .3000      2.0000       .6500      1.2000 <     .5000
CALCIUM         40.0000     40.0000     47.0000     39.0000     35.0000     49.0000     41.0000
LEAD              .0300 <     .0200 <     .0200       .0350       .0300       .2400      0.0000
MAGNESIUM       15.8000     15.0000     15.0000     13.5000     11.5000     18.0000     16.0000
MERCURY           .0007       .0004       .0008 <     .0001 <     .0001       .0017      0.0000
SELENIUM          .0060       .0120       .0810 <     .0006 <     .0006       .0001      0.0000
SULFITE           .5200       .4000      0.0000      0.0000      0.0000      0.0000      0.0000
SODIUM           0.0000     83.0000     79.0000    140.0000    103.0000    115.0000    130.0000
TOTAL ELEM     377.2617    283.5384    289.4068    415.5477    344.1847    563.4498    567.5000
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POND B GROUND WELL 2

WELL DESIG	GWB2	GWB2	GWB2	GWB2	GWB2	GWB2	GWB2	GWB2
DATE	741111.0000	741209.0000	750211.0000	750217.0000	750224.0000	750415.0000	750422.0000	750428.0000
REC NO.	3880.0000	3900.0000	3920.0000	3940.0000	3960.0000	3980.0000	4000.0000	4020.0000
PH	7.4000	6.9000	6.8000	6.7000	6.7000	6.7000	0.0000	6.7000
ALKALINITY	90.0000	58.0000	170.0000	170.0000	160.0000	160.0000	0.0000	160.0000
CHLORIDE	14.0000	86.0000	52.0000	50.0000	53.0000	52.0000	0.0000	53.0000
COD	0.0000	0.0000	15.0000	18.0000	9.0000	8.0000	14.0000	7.0000
COND	370.0000	710.0000	570.0000	570.0000	600.0000	540.0000	0.0000	530.0000
TDS	220.0000	580.0000	340.0000	330.0000	330.0000	300.0000	0.0000	310.0000
TSS	110.0000	11000.0000	0.0000	0.0000	61.0000	47.0000	0.0000	12.0000
SULFATE	47.0000	85.0000	20.0000	18.0000	14.0000	19.0000	0.0000	15.0000
ARSENIC	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050
BORON	< .1000	.4500	.4500	< .1000	< .1000	.4200	.1300	.1000
CALCIUM	35.0000	35.0000	34.0000	31.0000	32.0000	0.0000	29.0000	29.0000
LEAD	.1200	.0100	.0150	.1100	.0780	0.0000	.0460	.0300
MAGNESIUM	8.7000	8.9000	8.7000	9.0000	17.0000	0.0000	11.0000	11.0000
MERCURY	< .0002	0.0000	< .0002	.0005	.0008	.0022	.0005	.0013
SELENIUM	< .0020	< .0020	< .0020	< .0020	< .0020	.0030	.0040	.0030
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL ELEM	104.9272	215.3670	115.1722	108.2175	116.1858	71.4302	40.1855	108.1393

POND B GROUND WELL 2

WELL DESIG	GWB2	GWB2	GWB2	GWB2	GWB2	GWB2	GWB2	GWB2
DATE	750708.0000	750901.0000	751103.0000	760106.0000	760301.0000	760503.0000	760712.0000	770504.0000
REC NO.	4040.0000	4060.0000	4080.0000	4100.0000	4120.0000	4140.0000	4160.0000	4180.0000
PH	6.9000	6.8000	7.0000	7.2000	6.9000	7.2000	7.3000	6.8000
ALKALINITY	170.0000	210.0000	220.0000	270.0000	130.0000	170.0000	180.0000	170.0000
CHLORIDE	120.0000	92.0000	26.0000	52.0000	51.0000	54.0000	88.0000	72.0000
COD	10.0000	92.0000	8.0000	36.0000	4.0000	7.0000	13.0000	12.0000
COND	710.0000	800.0000	690.0000	350.0000	480.0000	560.0000	680.0000	550.0000
TDS	470.0000	540.0000	430.0000	0.0000	320.0000	360.0000	450.0000	370.0000
TSS	2300.0000	460.0000	130.0000	0.0000	600.0000	740.0000	640.0000	220.0000
SULFATE	34.0000	36.0000	39.0000	160.0000	30.0000	93.0000	65.0000	38.0000
ARSENIC	< .0050	.0070	< .0050	< .0050	.0050	< .0050	< .0050	.0060
BORON	.2500	1.1000	.2600	.1600	.1000	< .0100	.9000	.1500
CALCIUM	42.0000	63.0000	47.0000	69.0000	34.0000	37.0000	35.0000	41.0000
LEAD	< .0100	.0140	.0500	1.4000	.0630	.0110	.8200	.0600
MAGNESIUM	16.0000	16.0000	19.0000	120.0000	14.0000	11.0000	14.0000	12.0000
MEPCURY	< .0002	< .0002	.0003	.0006	.0020	< .0002	< .0002	.0014
SELENIUM	< .0020	.0020	< .0010	.0020	< .0040	.0050	.0030	< .0040
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	88.0000	110.0000	83.0000	110.0000	70.0000	73.0000	100.0000	75.0000
TOTAL ELEM	300.2672	318.1232	214.3163	512.5676	199.1740	268.0312	303.7282	238.2214

POND B GROUND WELL 2

WELL DESIG	GWB2	GWB2	GWB2	GWB2	GWB2
DATE	770707.0000	771108.0000	780316.0000	780511.0000	780628.0000
REC NO.	4200.0000	4220.0000	4240.0000	4260.0000	4280.0000
PH	7.4000	7.0000	7.1000	6.8000	8.2000
ALKALINITY	120.0000	74.0000	170.0000	160.0000	170.0000
CHLORIDE	120.0000	88.0000	74.0000	60.0000	0.0000
COD	16.0000	8.0000	0.0000	5.0000	9.0000
COND	530.0000	560.0000	620.0000	620.0000	680.0000
TDS	430.0000	450.0000	370.0000	380.0000	460.0000
TSS	2200.0000	0.0000	140.0000	34.0000	510.0000
SULFATE	30.0000	32.0000	28.0000	63.0000	50.0000
ARSENIC	.1500	< .0040	< .0020	.0070	< .0040
BORON	.1300	.1200	.1100	.0600	.1800
CALCIUM	25.0000	20.0000	26.0000	40.0000	33.0000
LEAD	< .0100	.0400	.1000	< .0100	.0900
MAGNESIUM	16.0000	11.0000	9.7000	14.0000	14.0000
MERCURY	.0006	.0003	< .0002	.0004	.0007
SELENIUM	.0050	.0030	< .0020	.0040	.0030
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	100.0000	78.0000	13.0000	75.0000	84.0000
TOTAL ELEM	291.2956	229.1673	150.9142	252.0814	181.2777

POND B GROUND WELL 2--- AEROSPACE ---

WELL DESIG	GWB2	GWB2	GWB2	GWB2	GWB2	GWB2
DATE	750211.0000	750415.0000	751103.0000	760503.0000	770504.0000	780316.0000
REC NO.	4300.0000	4320.0000	4340.0000	4360.0000	4380.0000	4400.0000
PH	7.5400	7.5800	7.2400	7.9100	7.3200	8.1400
ALKALINITY	171.0000	158.0000	233.0000	337.0000	180.0000	126.0000
CHLORIDE	80.0000	73.0000	110.0000	89.0000	105.0000	150.0000
COD	35.0000	15.0000	10.0000	0.0000	0.0000	0.0000
COND	530.0000	440.0000	610.0000	650.0000	540.0000	606.0000
TDS	320.0000	320.0000	408.0000	422.0000	352.0000	394.0000
TSS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SULFATE	18.0000	125.0000	27.0000	100.0000	28.0000	54.0000
ARSENIC	.0050	.0050	.0040	.0010	.0090	0.0000
BORON	1.2000	.8000	.3000	.3000	.0500	< .5000
CALCIUM	40.0000	12.0000	24.0000	55.0000	31.0000	19.0000
LEAD	.0500	.0900	.0100	.0100	.0300	0.0000
MAGNESIUM	12.0000	13.6000	14.0000	15.0000	11.0000	9.6000
MERCURY	.0001	.0004	.0001	.0004	.0001	0.0000
SELENIUM	.0090	.0070	.0140	.0900	.0006	0.0000
SULFITE	.3000	.2700	.5000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	83.0000	75.0000	7.7000	100.0000
TOTAL ELEM	151.5641	224.7724	258.8281	334.4014	182.7897	333.1000

POND C SUPERNATE

WELL DESIG	PSC	PSC	PSC	PSC	PSC	PSC	PSC	PSC
DATE	750428.0000	750505.0000	750708.0000	750901.0000	751103.0000	760106.0000	760308.0000	760503.0000
REC NO.	4420.0000	4440.0000	4460.0000	4480.0000	4500.0000	4520.0000	4540.0000	4560.0000
PH	11.2000	10.3000	8.3000	8.4000	8.3000	8.0000	7.3000	8.8000
ALKALINITY	170.0000	31.0000	21.0000	30.0000	28.0000	40.0000	41.0000	54.0000
CHLORIDE	560.0000	240.0000	440.0000	500.0000	430.0000	180.0000	430.0000	680.0000
COD	20.0000	17.0000	18.0000	19.0000	18.0000	10.0000	30.0000	35.0000
COND	2400.0000	2300.0000	2700.0000	3800.0000	3400.0000	1600.0000	3600.0000	0.0000
TDS	1600.0000	1500.0000	2100.0000	3200.0000	3000.0000	1800.0000	3800.0000	4300.0000
TSS	9.0000	31.0000	5.0000	11.0000	43.0000	82.0000	7.0000	22.0000
SULFATE	200.0000	200.0000	600.0000	1700.0000	1100.0000	890.0000	2300.0000	1600.0000
ARSENIC	.0080	< .0050	.0070	.0060	.0050	.0150	.0050	< .0050
BORON	.3400	.2600	1.5000	2.3000	.6700	0.0000	0.0000	1.1000
CALCIUM	590.0000	480.0000	450.0000	880.0000	600.0000	600.0000	1000.0000	560.0000
LEAD	.0160	.0360	< .0100	.0190	< .0100	.0250	< .0100	< .0100
MAGNESIUM	.2000	.4000	3.0000	5.3000	7.1000	8.4000	26.0000	18.0000
MERCURY	< .0002	< .0002	< .0002	< .0002	< .0002	.0003	< .0002	.0006
SELENIUM	.0030	.0020	< .0020	.0060	.0020	.0040	.0140	.0310
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	49.0000	75.0000	68.0000	29.0000	78.0000	120.0000
TOTAL ELEM	1350.5672	920.7032	1543.5192	3162.6312	2205.7872	1707.4443	3834.0292	2979.1466

POND C SUPERNATE

WELL DESIG	PSC	PSC	PSC	PSC	PSC	PSC	PSC	PSC
DATE	760706.0000	761005.0000	761109.0000	770302.0000	770505.0000	770707.0000	770926.0000	771216.0000
REC NO.	4580.0000	4600.0000	4620.0000	4640.0000	4660.0000	4680.0000	4700.0000	4720.0000
PH	7.8000	8.2000	8.0000	7.7000	6.6000	7.9000	7.4000	7.3000
ALKALINITY	37.0000	66.0000	44.0000	42.0000	30.0000	38.0000	34.0000	28.0000
CHLORIDE	500.0000	460.0000	220.0000	180.0000	45.0000	66.0000	60.0000	27.0000
COD	13.0000	51.0000	21.0000	15.0000	14.0000	17.0000	17.0000	4.0000
COND	2000.0000	3000.0000	2200.0000	2200.0000	1600.0000	2000.0000	2100.0000	1600.0000
TDS	2300.0000	3800.0000	2900.0000	2700.0000	2200.0000	2500.0000	2000.0000	1400.0000
TSS	15.0000	13.0000	6.0000	7.0000	6.0000	6.0000	13.0000	4.0000
SULFATE	1100.0000	1900.0000	2000.0000	1400.0000	1400.0000	1700.0000	1100.0000	860.0000
ARSENIC	.0200	.0350	.0120	< .0020	.0180	.0260	.0240	< .0020
BORON	23.0000	14.0000	7.4000	6.2000	3.1000	.5500	3.3000	1.3000
CALCIUM	460.0000	490.0000	690.0000	620.0000	540.0000	610.0000	680.0000	450.0000
LEAD	< .0100	< .0100	< .0100	.0100	< .0100	< .0100	< .0100	< .0100
MAGNESIUM	7.2000	25.0000	29.0000	20.0000	7.9000	7.4000	9.0000	5.8000
MERCURY	< .0002	< .0002	.0002	< .0002	.0005	< .0002	.0015	< .0002
SELENIUM	.0140	.0270	.0540	.0200	< .0020	.0190	.0120	.0080
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	16.0000	76.0000	38.0000	30.0000	11.0000	15.0000	13.0000	6.1000
TOTAL ELEM	2106.2442	2965.0722	2984.4762	2256.2322	2007.0305	2399.0052	1865.3475	1350.2202

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POND C SUPERNATE


WELL DESIG          PSC          PSC
DATE        780316.0000  780511.0000
REC NO.       4740.0000    4760.0000
PH               8.0000       7.4000
ALKALINITY      29.0000      32.0000
CHLORIDE        12.0000      21.0000
COD              6.0000      18.0000
COND          1700.0000    2400.0000
TDS           1500.0000    2300.0000
TSS              4.0000      21.0000
SULFATE        290.0000    1500.0000
ARSENIC           .0040        .0220
BORON             .5900       1.7000
CALCIUM        280.0000     670.0000
LEAD        <     .0100  <     .0100
MAGNESIUM        3.4000       7.5000
MERCURY     <     .0002  <     .0002
SELENIUM          .0030        .0050
SULFITE          0.0000       0.0000
SODIUM           1.7000       6.3000
TOTAL ELEM     587.7072    2206.5372
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POND C SUPERNATE    --- AEROSPACE ---


WELL DESIG          PSC          PSC          PSC          PSC          PSC          PSC          PSC
DATE        750428.0000  751103.0000  760503.0000  761109.0000  770505.0000  780309.0000  780316.0000
REC NO.       4780.0000    4800.0000    4820.0000    4840.0000    4860.0000    4880.0000    4900.0000
PH              11.4300       7.3200       8.2300       7.1500       7.0900       7.3800       7.4300
ALKALINITY     173.0000      35.0000      45.0000      40.0000      26.0000      13.6000      20.0000
CHLORIDE       610.0000     540.0000     680.0000     245.0000     150.0000      12.0000      10.0000
COD             49.0000      25.0000       0.0000       0.0000       0.0000       0.0000       0.0000
COND          2400.0000    3130.0000    4540.0000    2780.0000    1960.0000     962.0000    1230.0000
TDS           1560.0000    2960.0000    4220.0000    2750.0000    1996.0000     890.0000    1204.0000
TSS              0.0000       0.0000       0.0000       0.0000       0.0000       0.0000       0.0000
SULFATE        175.0000    1500.0000    1500.0000    1475.0000    1350.0000     588.0000     682.0000
ARSENIC           .0050        .0060        .0280        .0180        .0110        .0160       0.0000
BORON             .1000       2.4000       6.5000       7.8000       1.3000        .8500       1.5000
CALCIUM        340.0000     600.0000     850.0000     680.0000     550.0000     170.0000     230.0000
LEAD              .1400  <     .0100  <     .0200        .0450        .0400        .2000       0.0000
MAGNESIUM        3.7000       9.0000      22.0000      23.0000       6.9000       4.3000       4.6000
MERCURY           .0003        .0003        .0011  <     .0001  <     .0001        .0019       0.0000
SELENIUM          .0040        .0060        .1010        .0173        .0027        .0004       0.0000
SULFITE           .8500  <     .1000       0.0000       0.0000       0.0000       0.0000       0.0000
SODIUM           0.0000      68.0000     122.0000      48.0000      10.0000       2.0000       3.0000
TOTAL ELEM    1129.7993    2719.5223    3180.6501    2478.8804    2068.2538     777.3683     931.1000
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POND C LEACHATE

WELL DESIG	LWC	LWC	LWC	LWC	LWC	LWC	LWC	LWC
DATE	750428.0000	750429.0000	750505.0000	750707.0000	750901.0000	760106.0000	760301.0000	760517.0000
REC NO.	4920.0000	4940.0000	4960.0000	4980.0000	5000.0000	5020.0000	5040.0000	5060.0000
PH	10.4000	11.8000	11.9000	11.4000	9.0000	7.3000	8.1000	8.2000
ALKALINITY	99.0000	600.0000	720.0000	300.0000	44.0000	58.0000	30.0000	3.0000
CHLORIDE	2400.0000	2100.0000	2100.0000	1200.0000	1100.0000	1000.0000	380.0000	810.0000
COD	140.0000	140.0000	130.0000	1300.0000	66.0000	30.0000	18.0000	40.0000
COND	7500.0000	8500.0000	8400.0000	5600.0000	5000.0000	4000.0000	3200.0000	4000.0000
TDS	4700.0000	4600.0000	4100.0000	3200.0000	3300.0000	3500.0000	3000.0000	3800.0000
TSS	73.0000	36.0000	30.0000	2800.0000	36000.0000	370.0000	160.0000	370.0000
SULFATE	750.0000	44.0000	23.0000	190.0000	820.0000	870.0000	1000.0000	1200.0000
ARSENIC	< .0050	< .0050	< .0050	< .0050	.0200	.0200	.0200	.0200
BORON	.1900	.1300	.1000	.3700	1.4000	0.0000	2.5000	6.4000
CALCIUM	2000.0000	2000.0000	1900.0000	650.0000	550.0000	790.0000	980.0000	800.0000
LEAD	.0520	.1100	.1200	.2200	.0160	.1600	< .0100	< .0100
MAGNESIUM	5.4000	.4000	.1000	8.3000	.2000	8.8000	12.0000	8.9000
MERCURY	< .0002	< .0002	.0010	.0250	< .0002	.0036	< .0002	.0003
SELENIUM	.0110	.0110	.0100	.0080	< .0020	.0030	.0120	.0140
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	150.0000	180.0000	18.0000	53.0000	0.0000
TOTAL ELEM	5155.6582	4144.6562	4023.3360	2198.9280	2651.6382	2686.9866	2427.5422	2825.3443

POND C LEACHATE

WELL DESIG	LWC	LWC	LWC	LWC	LWC	LWC	LWC
DATE	760706.0000	770505.0000	770707.0000	770926.0000	780105.0000	780316.0000	780511.0000
REC NO.	5080.0000	5100.0000	5120.0000	5140.0000	5160.0000	5180.0000	5200.0000
PH	7.7000	6.9000	7.2000	7.3000	7.3000	8.0000	7.4000
ALKALINITY	60.0000	30.0000	42.0000	69.0000	48.0000	32.0000	48.0000
CHLORIDE	260.0000	160.0000	140.0000	260.0000	190.0000	81.0000	70.0000
COD	42.0000	10.0000	22.0000	33.0000	21.0000	8.0000	17.0000
COND	2600.0000	2400.0000	2400.0000	3400.0000	2700.0000	2500.0000	2600.0000
TDS	2900.0000	2800.0000	2800.0000	3000.0000	2400.0000	2400.0000	2400.0000
TSS	3900.0000	53.0000	1600.0000	2200.0000	2700.0000	47.0000	630.0000
SULFATE	1600.0000	1700.0000	1800.0000	1600.0000	1400.0000	1300.0000	1500.0000
ARSENIC	.0350	.0280	.0320	.0220	.0440	.0090	.0200
BORON	15.0000	4.4000	6.4000	5.5000	4.0000	1.2000	2.8000
CALCIUM	730.0000	620.0000	680.0000	850.0000	650.0000	540.0000	670.0000
LEAD	.0300	< .0100	.0150	.0260	.0510	< .0100	.0420
MAGNESIUM	13.0000	9.2000	9.0000	18.0000	13.0000	8.0000	10.0000
MERCURY	.0009	.0005	.0002	.0007	.0006	< .0002	.0007
SELENIUM	.0160	.0380	.0250	.0260	.0060	.0220	.0270
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	53.0000	27.0000	27.0000	64.0000	28.0000	17.0000	20.0000
TOTAL ELEM	2671.0819	2520.6765	2662.4722	2797.5747	2285.1016	1947.2412	2272.8897

POND C LEACHATE --- AEROSPACE ---

WELL DESIG	LWC	LWC	LWC	LWC	LWC	LWC	LWC	LWC
DATE	750211.0000	750428.0000	760121.0000	760301.0000	760503.0000	770302.0000	770505.0000	780309.0000
REC NO.	5220.0000	5240.0000	5260.0000	5280.0000	5300.0000	5320.0000	5340.0000	5360.0000
FH	7.4600	10.6100	6.8600	0.0000	7.2600	7.3300	6.9900	7.1700
ALKALINITY	56.0000	50.0000	39.0000	0.0000	40.0000	35.0000	26.0000	17.0000
CHLORIDE	42.0000	2562.0000	1050.0000	380.0000	590.0000	420.0000	260.0000	54.0000
COD	20.0000	0.0000	60.0000	0.0000	0.0000	0.0000	0.0000	0.0000
COND	430.0000	7500.0000	4160.0000	0.0000	4090.0000	3390.0000	2530.0000	2060.0000
TDS	260.0000	4720.0000	3540.0000	0.0000	3750.0000	3120.0000	2606.0000	2160.0000
TSS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SULFATE	225.0000	75.0000	1175.0000	1550.0000	1500.0000	1690.0000	1675.0000	1350.0000
ARSENIC	.0050	.0050	.0210	0.0000	.0230	.0020	.0180	.0330
BOPON	.1000	.1000	1.0000	0.0000	5.5000	5.0000	2.8000	2.6000
CALCIUM	20.0000	1980.0000	575.0000	600.0000	700.0000	680.0000	690.0000	450.0000
LEAD	.0400	.3600	< .0100	0.0000	< .0100	.0600	.2400	.2300
MAGNESIUM	14.0000	3.8000	9.0000	0.0000	12.0000	11.0000	7.0000	11.0000
MERCURY	.0003	.0001	.0012	0.0000	.0005	< .0001	< .0001	< .0001
SELENIUM	.0090	.0110	.0220	0.0000	.1730	.0206	.0053	.0001
SULFITE	0.0000	4.5000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	143.0000	0.0000	102.0000	88.0000	26.0000	15.0000
TOTAL ELEM	301.1543	4625.7761	2953.0542	2530.0000	2899.7065	2894.0827	2661.0634	1882.8632

POND C LEACHATE --- AEROSPACE ---

WELL DESIG	LWC
DATE	780316.0000
REC NO.	5380.0000
PH	7.0300
ALKALINITY	23.6000
CHLORIDE	62.0000
COD	0.0000
COND	2160.0000
TDS	2302.0000
TSS	0.0000
SULFATE	1388.0000
APSENIC	0.0000
BOPON	2.4000
CALCIUM	480.0000
LEAD	0.0000
MAGNESIUM	11.0000
MEPCURY	0.0000
SELENIUM	0.0000
SULFITE	0.0000
SODIUM	16.0000
TOTAL ELEM	1959.4000

POND C GROUND WELL 1

WELL DESIG	GWC1	GWC1	GWC1	GWC1	GWC1	GWC1	GWC1	GWC1
DATE	740722.0000	740729.0000	740805.0000	740903.0000	741007.0000	741209.0000	750211.0000	750423.0000
REC NO.	5400.0000	5420.0000	5440.0000	5460.0000	5480.0000	5500.0000	5520.0000	5540.0000
PH	7.7000	7.4000	7.4000	7.5000	7.0000	0.0000	6.6000	7.6000
ALKALINITY	130.0000	120.0000	130.0000	96.0000	47.0000	0.0000	130.0000	82.0000
CHLORIDE	10.0000	9.0000	10.0000	7.0000	13.0000	0.0000	14.0000	11.0000
COD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	12.0000	7.0000
COND	400.0000	460.0000	0.0000	0.0000	0.0000	0.0000	450.0000	340.0000
TDS	380.0000	330.0000	330.0000	450.0000	370.0000	0.0000	330.0000	240.0000
TSS	720.0000	81.0000	26.0000	0.0000	1000.0000	0.0000	0.0000	12.0000
SULFATE	56.0000	85.0000	67.0000	180.0000	78.0000	0.0000	55.0000	50.0000
ARSENIC	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050
BORON	< .1000	< .1000	< .1000	< .1000	< .1000	.2000	< .1000	.1100
CALCIUM	29.0000	34.0000	34.0000	83.0000	38.0000	0.0000	33.0000	15.0000
LEAD	.1200	.0400	.0320	< .0100	< .0100	0.0000	.0150	.0200
MAGNESIUM	6.1000	5.9000	5.7000	12.0000	7.3000	0.0000	48.0000	2.7000
MERCURY	0.0000	.0290	.0003	< .0002	< .0002	0.0000	.0004	.0011
SELENIUM	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL ELEM	101.3270	134.0760	116.8393	282.1172	136.4172	.2070	150.1224	78.8381

POND C GROUND WELL 1

WELL DESIG	GWC1	GWC1	GWC1	GWC1	GWC1	GWC1	GWC1	GWC1
DATE	750428.0000	750505.0000	750708.0000	750901.0000	751103.0000	760301.0000	760503.0000	760712.0000
REC NO.	5560.0000	5580.0000	5600.0000	5620.0000	5640.0000	5660.0000	5680.0000	5700.0000
PH	7.6000	6.7000	7.0000	6.9000	7.0000	6.5000	7.1000	6.9000
ALKALINITY	88.0000	110.0000	120.0000	80.0000	76.0000	80.0000	100.0000	76.0000
CHLORIDE	11.0000	12.0000	40.0000	13.0000	15.0000	24.0000	13.0000	14.0000
COD	5.0000	5.0000	5.0000	8.0000	7.0000	5.0000	15.0000	5.0000
COND	530.0000	450.0000	440.0000	470.0000	420.0000	360.0000	530.0000	360.0000
TDS	300.0000	420.0000	650.0000	550.0000	400.0000	330.0000	430.0000	320.0000
TSS	13.0000	28.0000	3000.0000	1200.0000	550.0000	1600.0000	160.0000	75.0000
SULFATE	0.0000	18.0000	180.0000	160.0000	88.0000	83.0000	190.0000	64.0000
ARSENIC	< .0050	< .0050	< .0050	.0200	< .0050	< .0100	.0100	< .0050
BORON	< .1000	< .1000	< .1000	.7000	.2400	.1200	.1200	.0700
CALCIUM	19.0000	22.0000	40.0000	48.0000	33.0000	230.0000	47.0000	18.0000
LEAD	.0220	.0220	.1500	.0630	.1500	.5200	.2400	.4100
MAGNESIUM	3.1000	4.6000	9.3000	7.4000	7.1000	32.0000	3.9000	3.4000
MERCURY	.0002	.0052	.0009	.0006	< .0002	< .0002	< .0002	< .0002
SELENIUM	< .0020	< .0050	< .0020	< .0020	< .0010	< .0040	.0070	< .0010
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	53.0000	54.0000	53.0000	62.0000	46.0000	54.0000
TOTAL ELEM	33.2292	56.7372	322.5579	283.1856	196.4962	431.6542	300.2772	153.8862

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POND C GROUND WELL 1

WELL DESIG          GWC1          GWC1          GWC1          GWC1          GWC1
DATE         770505.0000   771216.0000   780316.0000   780511.0000   780628.0000
REC NO.        5720.0000     5740.0000     5760.0000     5780.0000     5800.0000
PH                6.3000        6.5000        6.3000        6.5000        7.2000
ALKALINITY       90.0000      110.0000       73.0000       76.0000       60.0000
CHLORIDE         15.0000       17.0000       20.0000       24.0000       25.0000
COD              13.0000       40.0000       20.0000       11.0000        7.0000
COND            370.0000      460.0000      390.0000      420.0000      410.0000
TDS             340.0000      480.0000      330.0000      330.0000      370.0000
TSS             270.0000    12000.0000      240.0000      210.0000     2600.0000
SULFATE          64.0000       50.0000       56.0000       70.0000       66.0000
ARSENIC            .0020         .0120  <      .0020         .0050  <      .0040
BORON              .2800         .2000         .1000         .1700         .2900
CALCIUM          24.0000       34.0000       29.0000       19.0000       14.0000
LEAD               .0300         .1800         .0580  <      .0100         .0650
MAGNESIUM         4.2000        8.4000       22.0000        4.5000        3.6000
MERCURY            .0003         .0052  <      .0002  <      .0002         .0014
SELENIUM           .0040  <      .0020  <      .0020  <      .0010  <      .0010
SULFITE           0.0000        0.0000        0.0000        0.0000        0.0000
SODIUM           62.0000       72.0000       47.0000       66.0000       57.0000
TOTAL ELEM      169.5163      181.7992      174.1622      183.6862      165.9614


POND C GROUND WELL 1--- AEROSPACE ---

WELL DESIG          GWC1          GWC1          GWC1          GWC1          GWC1
DATE         740904.0000   750428.0000   751103.0000   770505.0000   780309.0000
REC NO.        5820.0000     5840.0000     5860.0000     5880.0000     5920.0000
PH                8.0800        7.3700        7.0800        6.8800        8.0500
ALKALINITY      106.0000       93.0000       76.0000       94.0000       81.0000
CHLORIDE         61.0000       55.0000       64.0000       70.0000       29.0000
COD               7.0000       48.0000       10.0000        0.0000        0.0000
COND            590.0000      330.0000      310.0000      360.0000      150.0000
TDS             460.0000      280.0000      340.0000      328.0000      316.0000
TSS               0.0000        0.0000        0.0000        0.0000        0.0000
SULFATE         250.0000       75.0000       70.0000       65.0000       64.0000
ARSENIC            .0050         .0050         .0020         .0080        0.0000
BORON              .1000         .1000         .5000  <      .0500  <      .5000
CALCIUM         480.0000       12.0000       16.0000       17.0000       12.0000
LEAD               .0500         .0200  <      .0200         .0350        0.0000
MAGNESIUM        18.0000        4.1000        5.0000        3.4000        4.1000
MERCURY            .0007         .0003         .0001  <      .0001        0.0000
SELENIUM           .0040         .0120         .0180         .0020        0.0000
SULFITE            .2000         .1900         .2000        0.0000        0.0000
SODIUM            0.0000        0.0000       57.0000       53.0000       52.0000
TOTAL ELEM      809.3597      146.4273      212.7401      208.4951      161.6000
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POND C GROUND WELL 2

WELL DESIG	GWC2	GWC2	GWC2	GWC2	GWC2	GWC2	GWC2	GWC2
DATE	740805.0000	740903.0000	741007.0000	741209.0000	750211.0000	750423.0000	750428.0000	750505.0000
REC NO.	5940.0000	5960.0000	5980.0000	6000.0000	6020.0000	6040.0000	6060.0000	6080.0000
PH	7.3000	7.3000	7.3000	0.0000	7.2000	7.2000	7.2000	7.1000
ALKALINITY	68.0000	80.0000	99.0000	0.0000	140.0000	150.0000	150.0000	160.0000
CHLORIDE	14.0000	15.0000	26.0000	0.0000	63.0000	85.0000	66.0000	100.0000
COD	0.0000	0.0000	0.0000	0.0000	13.0000	9.0000	9.0000	18.0000
COND	0.0000	0.0000	0.0000	0.0000	610.0000	540.0000	570.0000	650.0000
TDS	230.0000	170.0000	260.0000	0.0000	320.0000	320.0000	330.0000	400.0000
TSS	210.0000	0.0000	120.0000	0.0000	0.0000	48.0000	20.0000	87.0000
SULFATE	48.0000	30.0000	30.0000	0.0000	22.0000	17.0000	23.0000	52.0000
ARSENIC	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050	< .0050
BORON	< .1000	< .1000	< .1000	< .1000	< .1000	.1700	.2000	.2500
CALCIUM	31.0000	23.0000	26.0000	0.0000	38.0000	36.0000	36.0000	44.0000
LEAD	.0240	0.0000	< .0100	0.0000	.0440	.0220	.0200	.0580
MAGNESIUM	8.6000	8.4000	8.4000	0.0000	9.4000	12.0000	15.0000	13.0000
MERCURY	.0002	< .0002	< .0002	0.0000	.0002	.0003	.0008	.0028
SELENIUM	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL ELEM	101.7312	76.5072	90.5172	.1070	132.5512	150.1993	140.2278	209.3178

POND C GROUND WELL 2

WELL DESIG	GWC2	GWC2	GWC2	GWC2	GWC2	GWC2	GWC2	GWC2
DATE	750708.0000	750901.0000	751103.0000	760315.0000	760503.0000	760712.0000	770505.0000	780105.0000
REC NO.	6100.0000	6120.0000	6140.0000	6160.0000	6180.0000	6200.0000	6220.0000	6240.0000
PH	7.0000	7.2000	7.3000	7.0000	8.0000	7.5000	7.2000	7.2000
ALKALINITY	130.0000	120.0000	100.0000	130.0000	150.0000	130.0000	120.0000	84.0000
CHLORIDE	110.0000	110.0000	130.0000	0.0000	25.0000	37.0000	44.0000	10.0000
COD	12.0000	10.0000	23.0000	5.0000	25.0000	5.0000	19.0000	21.0000
COND	850.0000	910.0000	980.0000	380.0000	680.0000	410.0000	480.0000	290.0000
TDS	540.0000	840.0000	650.0000	230.0000	500.0000	270.0000	370.0000	300.0000
TSS	3800.0000	2500.0000	4300.0000	850.0000	540.0000	270.0000	830.0000	4800.0000
SULFATE	110.0000	170.0000	200.0000	26.0000	240.0000	41.0000	92.0000	37.0000
ARSENIC	< .0050	< .0050	.0050	.0100	.0100	< .0050	.0130	.0340
BORON	2.5000	2.4000	.6100	.5900	.6500	.3600	.8100	.5800
CALCIUM	0.0000	120.0000	290.0000	28.0000	98.0000	37.0000	25.0000	39.0000
LEAD	0.0000	.1000	.3000	.4800	.0280	.3200	.0650	.0780
MAGNESIUM	0.0000	34.0000	84.0000	22.0000	13.0000	15.0000	16.0000	12.0000
MERCURY	.0009	< .0002	< .0002	.0002	< .0004	< .0002	.0013	.0010
SELENIUM	< .0020	< .0020	< .0010	.0030	.0040	.0010	.0060	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	52.0000	59.0000	26.0000	23.0000	28.0000	58.0000	24.0000
TOTAL ELEM	222.5079	488.5072	763.9162	103.0832	399.6924	158.6862	235.8953	122.6950

POND C GROUND WELL 2

WELL DESIG	GWC2	GWC2	GWC2
DATE	780316.0000	780511.0000	780628.0000
REC NO.	6260.0000	6280.0000	6300.0000
PH	7.4000	7.5000	7.8000
ALKALINITY	98.0000	100.0000	110.0000
CHLORIDE	6.0000	20.0000	21.0000
COD	28.0000	4.0000	4.0000
COND	280.0000	350.0000	360.0000
TDS	190.0000	220.0000	280.0000
TSS	1900.0000	150.0000	2300.0000
SULFATE	34.0000	43.0000	6.0000
ARSENIC	< .0020	.0050	< .0040
BORON	.4000	.2900	.2600
CALCIUM	36.0000	44.0000	37.0000
LEAD	.0730	.0350	.0850
MAGNESIUM	15.0000	10.0000	9.0000
MERCURY	< .0002	.0003	.0010
SELENIUM	< .0020	< .0100	< .0010
SULFITE	0.0000	0.0000	0.0000
SODIUM	12.0000	17.0000	15.0000
TOTAL ELEM	103.4772	134.3403	88.3540

POND C GROUND WELL 2--- AEROSPACE ---

WELL DESIG	GWC2	GWC2	GWC2	GWC2	GWC2	GWC2	GWC2	GWC2
DATE	740904.0000	750428.0000	751103.0000	760315.0000	760503.0000	770505.0000	780309.0000	780316.0000
REC NO.	6320.0000	6340.0000	6360.0000	6380.0000	6400.0000	6420.0000	6440.0000	6460.0000
PH	7.8800	7.3500	7.2000	0.0000	7.8100	7.3100	8.1200	8.2600
ALKALINITY	83.0000	149.0000	101.0000	0.0000	141.0000	126.0000	92.0000	84.0000
CHLORIDE	41.0000	99.0000	195.0000	42.0000	54.0000	98.0000	23.0000	8.4000
COD	0.0000	75.0000	10.0000	0.0000	0.0000	0.0000	0.0000	0.0000
COND	290.0000	530.0000	950.0000	0.0000	550.0000	520.0000	278.0000	246.0000
TDS	154.0000	340.0000	672.0000	0.0000	406.0000	324.0000	206.0000	158.0000
TSS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SULFATE	37.0000	25.0000	150.0000	0.0000	110.0000	83.0000	30.0000	30.0000
ARSENIC	.0050	.0050	.0040	0.0000	.0010	< .0010	.0330	0.0000
BORON	.4000	.1000	3.3000	0.0000	.5000	.8000	< .5000	< .5000
CALCIUM	36.0000	32.0000	48.0000	28.0000	78.0000	44.0000	26.0000	21.0000
LEAD	.0300	.0500	.0200	0.0000	.0100	.0300	.2000	0.0000
MAGNESIUM	13.0000	13.4000	40.0000	0.0000	15.0000	11.9000	11.0000	8.0000
MERCURY	.0006	.0003	.0002	0.0000	.0006	< .0001	.0016	0.0000
SELENIUM	.0050	.0100	.0040	0.0000	.0520	< .0006	.0001	0.0000
SULFITE	.1000	.2800	.2000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	58.0000	0.0000	26.0000	53.0000	15.0000	11.0000
TOTAL ELEM	127.5406	169.8453	494.5282	70.0000	283.5636	290.7317	105.7347	78.9000

POND D SUPERNATE

WELL DESIG	PSD	PSD	PSD	PSD	PSD	PSD	PSD	PSD
DATE	741028.0000	741209.0000	750211.0000	750217.0000	750224.0000	750428.0000	750708.0000	750901.0000
REC NO.	6480.0000	6500.0000	6520.0000	6540.0000	6560.0000	6580.0000	6600.0000	6620.0000
PH	8.9000	9.2000	8.5000	8.3000	8.1000	8.0000	8.4000	8.0000
ALKALINITY	270.0000	310.0000	97.0000	120.0000	170.0000	35.0000	40.0000	38.0000
CHLORIDE	2400.0000	1000.0000	950.0000	1100.0000	670.0000	260.0000	200.0000	200.0000
COD	0.0000	170.0000	11.0000	19.0000	14.0000	16.0000	31.0000	39.0000
COND	9000.0000	5200.0000	4000.0000	5600.0000	3700.0000	1900.0000	2700.0000	3300.0000
TDS	7300.0000	4400.0000	3400.0000	4400.0000	3000.0000	1700.0000	2900.0000	3500.0000
TSS	98.0000	1700.0000	2900.0000	0.0000	90.0000	8.0000	7.0000	11.0000
SULFATE	1700.0000	980.0000	1100.0000	2000.0000	950.0000	750.0000	130.0000	2600.0000
ARSENIC	.1800	.0200	.2400	.3000	.1200	.0050	.0350	.4700
BORON	110.0000	42.0000	49.0000	64.0000	35.0000	11.0000	10.0000	16.0000
CALCIUM	1500.0000	1100.0000	830.0000	1000.0000	970.0000	360.0000	850.0000	1200.0000
LEAD	< .0100	< .0100	.0270	< .0100	.0120	< .0100	< .0100	.0230
MAGNESIUM	190.0000	40.0000	170.0000	200.0000	180.0000	34.0000	17.0000	22.0000
MERCURY	< .0002	< .0002	< .0002	< .0002	< .0002	< .0002	.0016	< .0002
SELENIUM	.0400	.0280	.0750	.0800	.0600	.0180	< .0020	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	13.0000	20.0000
TOTAL ELEM	5900.2302	3162.0582	3099.3422	4364.3902	2805.1922	1415.0332	1220.0486	4058.4952

POND D SUPERNATE

WELL DESIG	PSD	PSD	PSD	PSD	PSD	PSD	PSD	PSD
DATE	751103.0000	760106.0000	760301.0000	760503.0000	760706.0000	760909.0000	761109.0000	770223.0000
REC NO.	6640.0000	6660.0000	6680.0000	6700.0000	6720.0000	6740.0000	6760.0000	6780.0000
PH	8.3000	7.6000	7.3000	7.8000	7.4000	7.4000	7.1000	7.7000
ALKALINITY	33.0000	30.0000	24.0000	36.0000	42.0000	860.0000	30.0000	53.0000
CHLORIDE	90.0000	32.0000	23.0000	23.0000	50.0000	14.0000	90.0000	26.0000
COD	36.0000	5.0000	0.0000	35.0000	25.0000	45.0000	17.0000	24.0000
COND	2500.0000	1000.0000	1000.0000	1600.0000	1100.0000	1800.0000	1900.0000	1800.0000
TDS	2600.0000	1000.0000	960.0000	1600.0000	1200.0000	680.0000	2700.0000	2400.0000
TSS	14.0000	18.0000	2.0000	74.0000	4.0000	9200.0000	8.0000	10.0000
SULFATE	1200.0000	660.0000	650.0000	850.0000	1300.0000	2000.0000	2100.0000	160.0000
ARSENIC	.5800	< .0050	.0250	.0100	.0480	.1800	.0140	.0040
BORON	11.0000	0.0000	1.0000	1.0000	.7000	1.7000	2.6000	3.4000
CALCIUM	710.0000	360.0000	340.0000	320.0000	320.0000	470.0000	580.0000	610.0000
LEAD	< .0100	.0100	< .0100	< .0100	< .0100	.0910	< .0100	< .0100
MAGNESIUM	36.0000	14.0000	14.0000	14.0000	8.9000	32.0000	41.0000	23.0000
MERCURY	< .0002	< .0002	.0006	< .0002	< .0002	< .0002	.0006	.0006
SELENIUM	< .0010	< .0020	.0040	< .0040	< .0010	.0020	.0030	.0060
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	22.0000	7.0000	7.5000	12.0000	0.0000	13.0000	19.0000	13.0000
TOTAL ELEM	2069.5912	1073.0172	1035.5396	1220.0242	1679.6592	2530.9732	2832.6276	835.4206

POND D SUPERNATE

WELL DESIG	PSD	PSD	PSD	PSD	PSD	PSD	PSD	PSD
DATE	770504.0000	770707.0000	770926.0000	771104.0000	771216.0000	780316.0000	780511.0000	780628.0000
REC NO.	6800.0000	6820.0000	6840.0000	6860.0000	6880.0000	6900.0000	6920.0000	6940.0000
PH	6.3000	7.1000	7.3000	7.5000	7.0000	7.3000	7.2000	7.2000
ALKALINITY	30.0000	26.0000	30.0000	33.0000	26.0000	36.0000	40.0000	35.0000
CHLORIDE	8.0000	11.0000	7.0000	7.0000	3.0000	2.0000	2.0000	2.0000
COD	16.0000	24.0000	32.0000	22.0000	9.0000	7.0000	22.0000	37.0000
COND	1100.0000	1600.0000	1600.0000	1900.0000	620.0000	450.0000	780.0000	1700.0000
TDS	1200.0000	1900.0000	1500.0000	1800.0000	450.0000	330.0000	610.0000	1500.0000
TSS	5.0000	5.0000	7.0000	11.0000	3.0000	3.0000	7.0000	16.0000
SULFATE	850.0000	1300.0000	910.0000	1100.0000	280.0000	58.0000	350.0000	1000.0000
ARSENIC	.0250	.0870	.0860	.0730	< .0020	.0040	.0220	.0820
BORON	.8000	.9400	.5400	.7100	.2200	.1200	.1300	.5000
CALCIUM	340.0000	460.0000	480.0000	710.0000	140.0000	70.0000	170.0000	470.0000
LEAD	< .0100	< .0100	< .0100	< .0100	< .0100	< .0100	< .0100	< .0100
MAGNESIUM	8.9000	8.8000	9.4000	12.0000	5.8000	3.7000	6.4000	11.0000
MERCURY	< .0002	< .0002	.0008	< .0002	< .0002	< .0002	.0006	.0003
SELENIUM	< .0040	.0030	< .0020	.0010	< .0020	< .0020	< .0010	< .0010
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	7.3000	9.3000	7.8000	7.4000	4.2000	2.2000	4.2000	6.7000
TOTAL ELEM	1215.0392	1790.1402	1414.8388	1837.1542	433.2342	136.0362	532.7636	1490.2933

POND D SUPERNATE --- AEROSPACE ---

WELL DESIG	PSD	PSD	PSD	PSD	PSD	PSD	PSD	PSD
DATE	741028.0000	750211.0000	750707.0000	751103.0000	760503.0000	761109.0000	770505.0000	780309.0000
REC NO.	6960.0000	6980.0000	7000.0000	7020.0000	7040.0000	7060.0000	7080.0000	7100.0000
PH	8.7000	8.2700	7.4800	7.2800	6.9200	7.2300	6.8100	7.3200
ALKALINITY	0.0000	68.0000	45.0000	41.0000	35.0000	46.0000	27.0000	6.0000
CHLORIDE	3000.0000	1100.0000	205.0000	225.0000	84.0000	135.0000	110.0000	1.5000
COD	0.0000	0.0000	95.0000	40.0000	0.0000	0.0000	0.0000	0.0000
COND	5600.0000	3600.0000	2440.0000	2380.0000	1580.0000	2330.0000	1190.0000	73.0000
TDS	6340.0000	3020.0000	3320.0000	2530.0000	1620.0000	2514.0000	1118.0000	36.0000
TSS	30.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SULFATE	1550.0000	950.0000	1700.0000	1625.0000	1000.0000	1475.0000	775.0000	12.0000
ARSENIC	.0050	.2800	.0900	.0040	.0340	.0160	.0140	< .0040
BORON	98.0000	44.0000	8.0000	7.8000	1.5000	4.0000	1.2000	< .5000
CALCIUM	1640.0000	560.0000	460.0000	600.0000	400.0000	650.0000	330.0000	11.0000
LEAD	.0400	.2100	.0500	< .0100	< .0100	.0350	.0600	.2000
MAGNESIUM	.6000	152.0000	15.5000	37.0000	19.0000	30.0000	7.0000	1.1000
MERCURY	0.0000	0.0000	0.0000	.0002	.0013	< .0001	< .0001	.0006
SELENIUM	.0409	.0620	.0020	.0020	.0170	< .0006	.0027	.0001
SULFITE	2.8000	1.5000	.3600	.1000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	26.0000	120.0000	22.0000	7.8000	1.0000
TOTAL ELEM	6291.4859	2808.0520	2389.0020	2520.9162	1624.5623	2316.0517	1231.0768	27.3047

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POND D SUPERNATE    --- AEROSPACE ---

WELL DESIG         PSD
DATE        780316.0000
REC NO.       7120.0000
PH               7.5700
ALKALINITY      23.0000
CHLORIDE         2.2000
COD              0.0000
COND           311.0000
TDS            258.0000
TSS              0.0000
SULFATE        135.0000
ARSENIC          0.0000
BORON             .8000
CALCIUM         46.0000
LEAD             0.0000
MAGNESIUM        4.1000
MERCURY          0.0000
SELENIUM         0.0000
SULFITE          0.0000
SODIUM           2.5000
TOTAL ELEM     190.6000
```

POND D LEACHATE

WELL DESIG	LWD	LWD	LWD	LWD	LWD	LWD	LWD	LWD
DATE	741028.0000	741209.0000	750211.0000	750217.0000	750228.0000	750428.0000	750707.0000	750901.0000
REC NO.	7140.0000	7160.0000	7180.0000	7200.0000	7220.0000	7240.0000	7260.0000	7280.0000
PH	7.6000	8.8000	9.0000	9.1000	9.0000	8.7000	8.3000	7.7000
ALKALINITY	40.0000	200.0000	160.0000	140.0000	120.0000	120.0000	110.0000	54.0000
CHLORIDE	210.0000	0.0000	1400.0000	310.0000	560.0000	1500.0000	810.0000	680.0000
COD	0.0000	60.0000	13.0000	15.0000	0.0000	27.0000	20.0000	21.0000
COND	1700.0000	6500.0000	5000.0000	4300.0000	3200.0000	4400.0000	4600.0000	4200.0000
TDS	1300.0000	5200.0000	4200.0000	3700.0000	3500.0000	4000.0000	4500.0000	4000.0000
TSS	180.0000	220.0000	0.0000	0.0000	34.0000	20.0000	1400.0000	100.0000
SULFATE	590.0000	580.0000	1200.0000	0.0000	1200.0000	1600.0000	1100.0000	1700.0000
ARSENIC	.0050	.0200	.0880	.1100	.0700	.1600	.0080	1.0000
BORON	4.4000	89.0000	58.0000	48.0000	39.0000	47.0000	55.0000	54.0000
CALCIUM	240.0000	1500.0000	1200.0000	990.0000	1200.0000	1100.0000	940.0000	1200.0000
LEAD	< .0100	< .0100	.0150	.0370	.0280	.0300	.1800	.0210
MAGNESIUM	29.0000	76.0000	66.0000	58.0000	84.0000	140.0000	180.0000	170.0000
MERCURY	< .0002	< .0002	.0007	.0035	.0013	.0008	.0075	< .0002
SELENIUM	< .0020	.0480	< .0020	.1000	.0160	.0080	.0480	.0140
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	38.0000	30.0000
TOTAL ELEM	1073.4172	2245.0782	3924.1057	1406.2505	3083.1153	4387.1988	3123.2435	3835.0352

POND D LEACHATE

WELL DESIG	LWD	LWD	LWD	LWD	LWD	LWD	LWD	LWD
DATE	751103.0000	760106.0000	760301.0000	760503.0000	760706.0000	760909.0000	761109.0000	770215.0000
REC NO.	7300.0000	7320.0000	7340.0000	7360.0000	7380.0000	7400.0000	7420.0000	7440.0000
PH	6.9000	9.0000	8.8000	7.6000	7.4000	6.0000	4.6000	6.8000
ALKALINITY	31.0000	68.0000	48.0000	28.0000	54.0000	11.0000	1.0000	11.0000
CHLORIDE	450.0000	260.0000	56.0000	180.0000	190.0000	100.0000	100.0000	100.0000
COD	36.0000	180.0000	82.0000	40.0000	54.0000	32.0000	46.0000	9.0000
COND	3500.0000	2600.0000	2500.0000	2500.0000	2400.0000	2100.0000	2000.0000	2200.0000
TDS	3400.0000	2800.0000	2600.0000	2600.0000	3000.0000	2600.0000	2700.0000	2600.0000
TSS	120.0000	220.0000	23.0000	7.0000	2400.0000	4200.0000	10.0000	27.0000
SULFATE	1200.0000	1200.0000	1100.0000	1200.0000	1500.0000	2100.0000	2300.0000	1800.0000
ARSENIC	.0400	.1700	.4800	.1200	.4800	.1700	.4500	.2400
BORON	31.0000	16.0000	9.5000	8.3000	13.0000	7.4000	8.0000	4.6000
CALCIUM	940.0000	1000.0000	1000.0000	470.0000	640.0000	350.0000	640.0000	700.0000
LEAD	< .0100	.0700	.0750	.0100	.0210	.0220	< .0100	< .0100
MAGNESIUM	79.0000	26.0000	18.0000	14.0000	29.0000	20.0000	22.0000	19.0000
MERCURY	< .0002	.0004	.0002	< .0002	.0008	< .0002	< .0002	< .0002
SELENIUM	.0060	< .0040	< .0040	.0080	.0320	.0020	.0130	.0100
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	14.0000	8.7000	11.0000	17.0000	22.0000	85.0000	10.0000	12.0000
TOTAL ELEM	2714.0562	2510.9444	2195.0592	1889.4382	2394.5338	2662.5942	3080.4732	2635.8602

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POND D LEACHATE

WELL DESIG            LWD          LWD          LWD          LWD          LWD          LWD          LWD          LWD
DATE          770302.0000  770504.0000  770713.0000  770926.0000  771104.0000  771220.0000  780316.0000  780511.0000
REC NO.         7460.0000    7480.0000    7500.0000    7520.0000    7540.0000    7560.0000    7580.0000    7600.0000
PH                 6.2000       4.8000       5.4000       5.4000       9.4000       4.7000       4.0000       4.1000
ALKALINITY         8.0000       4.0000       5.0000       6.0000      75.0000       1.0000       0.0000       0.0000
CHLORIDE         100.0000      52.0000      44.0000      24.0000      69.0000      16.0000      14.0000      11.0000
COD               58.0000      36.0000     120.0000     320.0000      34.0000      42.0000      44.0000       5.0000
COND            2000.0000    2000.0000    2300.0000    2900.0000    2600.0000    2500.0000    2300.0000    2300.0000
TDS             2600.0000    2600.0000    3300.0000    2800.0000    2600.0000    2500.0000    2300.0000    2300.0000
TSS               46.0000     100.0000    1400.0000    6500.0000    4200.0000    4400.0000    1600.0000     130.0000
SULFATE         1800.0000    1900.0000    2100.0000    1800.0000    1800.0000    1500.0000    1200.0000    1500.0000
ARSENIC             .0700        .7000        .1600        .2200        .0140        .6200        .0880        .4400
BORON             16.0000       4.8000       4.6000       4.0000       3.3000       2.2000       1.2000       1.3000
CALCIUM          570.0000     660.0000     630.0000     850.0000     990.0000     710.0000     680.0000     580.0000
LEAD                .0100        .0120 <      .0100        .0150        .0260        .0220 <      .0100        .0500
MAGNESIUM         15.0000      18.0000      22.0000      26.0000      12.0000       8.8000       7.1000       7.1000
MERCURY       <     .0002        .0006 <      .0002        .0019        .0006        .0008 <      .0002        .0010
SELENIUM            .0140        .0210        .0140        .1100        .0300        .0060        .0020        .0030
SULFITE            0.0000       0.0000       0.0000       0.0000       0.0000       0.0000       0.0000       0.0000
SODIUM            13.0000      11.0000      16.0000      12.0000       8.5000       9.3000       7.7000       8.1000
TOTAL ELEM      2514.0942    2646.5336    2816.7842    2716.3469    2882.8706    2246.9488    1910.1002    2107.9940


POND D LEACHATE

WELL DESIG            LWD
DATE          780628.0000
REC NO.         7620.0000
PH                 6.3000
ALKALINITY         9.0000
CHLORIDE           9.0000
COD               19.0000
COND            2400.0000
TDS             2300.0000
TSS              330.0000
SULFATE         1500.0000
ARSENIC             .0620
BORON               .6800
CALCIUM          810.0000
LEAD                .0540
MAGNESIUM          6.3000
MERCURY             .0012
SELENIUM      <     .0010
SULFITE            0.0000
SODIUM             8.3000
TOTAL ELEM      2334.5982
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POND D LEACHATE      --- AEROSPACE ---

WELL DESIG      LWD         LWD         LWD         LWD         LWD         LWD         LWD         LWD   
DATE       741028.0000 750211.0000 750707.0000 751103.0000 760121.0000 760503.0000 761109.0000 770302.0000
REC NO.      7640.0000   7660.0000   7680.0000   7700.0000   7720.0000   7740.0000   7760.0000   7780.0000
PH              7.6200      8.9600      8.0800      4.5900      7.7900      5.6500      2.6000      2.8000
ALKALINITY      0.0000     53.0000    130.0000      0.0000      1.0000      3.0000      0.0000      0.0000
CHLORIDE      285.0000   1300.0000    940.0000    490.0000    970.0000    240.0000    170.0000    155.0000
COD            75.0000      0.0000     95.0000     25.0000     50.0000      0.0000      0.0000      0.0000
COND         1600.0000   5000.0000   4270.0000    570.0000   2740.0000   2380.0000   2670.0000   2520.0000
TDS          1210.0000   3960.0000   4240.0000   3370.0000   2970.0000   2560.0000   2436.0000   2514.0000
TSS           790.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SULFATE       425.0000   1425.0000   1600.0000   1750.0000   1375.0000   1400.0000   1450.0000   1725.0000
APSENIC          .0040       .0300       .2100       .0120       .3400       .9050       .3200       .6700
BOFON           7.8000     52.0000     58.0000     32.0000      1.3000      6.5000      8.8000      6.0000
CALCIUM       150.0000    960.0000    900.0000    760.0000    675.0000    600.0000    650.0000    630.0000
LEAD             .0130       .2600       .0500 <     .0100 <     .0100 <     .0100       .0250       .0650
MAGNESIUM       8.1000     63.0000     18.0000     99.0000     37.0000     18.0000     14.0000     13.0000
MEPCURY         0.0000      0.0000       .0002       .0005       .0012       .0013 <     .0001 <     .0001
SELENIUM         .0066       .0160       .0550       .0060       .0040       .0650       .0047 <     .0006
SULFITE         1.3000      6.1000       .4000      1.0000      0.0000      0.0000      0.0000      0.0000
SODIUM          0.0000      0.0000      0.0000     14.0000     17.0000     17.0000     10.0000     10.0000
TOTAL ELEM    877.2236   3806.4060   3516.7152   3146.0285   3075.6552   2282.4813   2303.1498   2539.7357


POND D LEACHATE      --- AEPOSPACE ---

WELL DESIG      LWD         LWD         LWD   
DATE       770504.0000 780309.0000 780316.0000
REC NO.      7800.0000   7820.0000   7840.0000
PH              5.3200      4.1800      4.2800
ALKALINITY      2.0000      0.0000      0.0000
CHLCPIDE      180.0000     15.0000      9.0000
COD             0.0000      0.0000      0.0000
COND         2360.0000   2070.0000   2060.0000
TDS          2402.0000   2164.0000   2277.0000
TSS             0.0000      0.0000      0.0000
SULFATE      1625.0000   1400.0000   1475.0000
ARSENIC         5.3000       .2500      0.0000
EOFON           4.7500      2.6000      2.2000
CALCIUM       660.0000    460.0000    500.0000
LEAD             .2300       .1400      9.8000
MAGNESIUM      13.9000      8.8000      0.0000
MEPCUPY          .0003       .0002      0.0000
SELENIUM         .0013       .0003      0.0000
SULFITE         0.0000      0.0000      0.0000
SODIUM         10.2000      7.0000      9.5000
TOTAL ELEM   2499.3816   1893.7905   2005.5000
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POND D GROUND WELL 1

WELL DESIG          GWD1        GWD1        GWD1        GWD1        GWD1        GWD1        GWD1        GWD1
DATE         740722.0000 740729.0000 740805.0000 740903.0000 741007.0000 741028.0000 741104.0000 741111.0000
REC NO.        7860.0000   7880.0000   7900.0000   7920.0000   7940.0000   7960.0000   7980.0000   8000.0000
PH                7.1000      6.8000      6.7000      7.0000      6.8000      6.9000      7.3000      7.8000
ALKALINITY       72.0000    110.0000    140.0000    140.0000     60.0000     52.0000    100.0000     52.0000
CHLORIDE         20.0000     50.0000     72.0000    110.0000     89.0000    170.0000     17.0000     12.0000
COD               0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
COND            220.0000    420.0000      0.0000      0.0000      0.0000    670.0000    670.0000    600.0000
TDS             210.0000    260.0000    330.0000    410.0000    330.0000    420.0000    510.0000      0.0000
TSS            2100.0000    100.0000     15.0000      0.0000     64.0000   6600.0000   2200.0000      0.0000
SULFATE          16.0000     22.0000     14.0000     12.0000     40.0000     85.0000    160.0000    340.0000
ARSENIC            .0150       .0080       .0060       .0050       .0050 <     .0050 <     .0050 <     .0050
BORON             0.0000 <     .1000 <     .1000 <     .1000 <     .1000 <     .1000       .2500 <     .1000
CALCIUM           0.0000     27.0000     30.0000     29.0000     18.0000     17.0000      0.0000      0.0000
LEAD              0.0000       .0790       .0490      0.0000       .0100 <     .0100      0.0000      0.0000
MAGNESIUM         0.0000     11.0000     11.0000     13.0000      6.8000      7.3000      0.0000      0.0000
MERCURY     <      .0002       .0010 <     .0002 <     .0002 <     .0002 <     .0002      0.0000      0.0000
SELENIUM    <      .0020 <     .0020 <     .0020 <     .0020 <     .0020 <     .0020 <     .0020 <     .0020
SULFITE           0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SODIUM            0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
TOTAL ELEM       36.0172    110.1900    127.1572    164.1072    153.9172    279.4172    177.2570    352.1070


POND D GROUND WELL 1

WELL DESIG          GWD1        GWD1        GWD1        GWD1        GWD1        GWD1        GWD1        GWD1
DATE         741209.0000 750211.0000 750217.0000 750224.0000 750428.0000 750708.0000 750901.0000 751103.0000
REC NO.        8020.0000   8040.0000   8060.0000   8080.0000   8100.0000   8120.0000   8140.0000   8160.0000
FH                0.0000      6.9000      6.7000      6.7000      6.9000      6.9000      7.0000      7.1000
ALKALINITY        0.0000    140.0000    150.0000    140.0000    150.0000    140.0000    140.0000     54.0000
CHLORIDE          0.0000    150.0000    100.0000    100.0000    240.0000    160.0000    320.0000    320.0000
COD               0.0000     14.0000     24.0000     16.0000     14.0000     22.0000     13.0000      0.0000
COND              0.0000    700.0000    660.0000    680.0000    690.0000    890.0000   1400.0000   1200.0000
TDS               0.0000    420.0000    380.0000    390.0000    410.0000    740.0000    870.0000    800.0000
TSS               0.0000      0.0000      0.0000    190.0000     12.0000    720.0000    340.0000    170.0000
SULFATE           0.0000     24.0000      7.0000      9.0000     38.0000     74.0000    320.0000    130.0000
ARSENIC     <      .0050 <     .0050 <     .0050 <     .0050 <     .0050 <     .0050       .0050 <     .0050
BORON       <      .1000      0.0000 <     .1000       .1300       .1600       .2200       .6000       .2400
CALCIUM           0.0000     66.0000     38.0000     37.0000      0.0000     53.0000     99.0000    160.0000
LEAD              0.0000       .0160       .0320       .0900      0.0000       .2600       .0190       .3400
MAGNESIUM         0.0000      9.1000      8.9000     16.0000      0.0000     22.0000     29.0000     61.0000
MERCURY           0.0000 <     .0002       .0002       .0020       .0005       .0011 <     .0002 <     .0002
SELENIUM    <      .0020 <     .0020 <     .0020 <     .0020 <     .0020 <     .0020 <     .0020 <     .0010
SULFITE           0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SODIUM            0.0000      0.0000      0.0000      0.0000      0.0000    110.0000    120.0000    160.0000
TOTAL ELEM         .1070    249.1232    154.0392    162.2290    278.1675    419.4881    888.6262    831.5862
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POND D GROUND WELL 1

WELL DESIG          GWD1        GWD1        GWD1        GWD1        GWD1        GWD1        GWD1        GWD1
DATE         760315.0000 760503.0000 760712.0000 760914.0000 770504.0000 771216.0000 780316.0000 780511.0000
REC NO.        8180.0000   8200.0000   8220.0000   8240.0000   8260.0000   8280.0000   8300.0000   8320.0000
PH                6.5000      7.1000      7.3000      6.7000      6.5000      6.6000      7.0000      7.1000
ALKALINITY       61.0000     86.0000    110.0000     82.0000     75.0000     53.0000     76.0000     98.0000
CHLORIDE          0.0000    240.0000    350.0000    450.0000    310.0000    280.0000    300.0000    240.0000
COD              13.0000     27.0000     34.0000     42.0000     38.0000    130.0000     60.0000     23.0000
COND           1300.0000   1100.0000   1300.0000   1500.0000   1400.0000   1300.0000   1600.0000   1300.0000
TDS             810.0000    650.0000    830.0000   1100.0000    750.0000    770.0000    880.0000    890.0000
TSS             490.0000    400.0000    140.0000   1300.0000   1300.0000   6700.0000    210.0000   5600.0000
SULFATE          20.0000     40.0000     40.0000    110.0000     60.0000    100.0000    150.0000     48.0000
ARSENIC      <     .0100 <     .0050 <     .0050 <     .0050       .0380       .0090 <     .0020       .1200
BOPON              .0700       .1300       .1700       .1900       .3000       .2400       .2000       .1100
CALCIUM         160.0000     40.0000     82.0000     77.0000     64.0000     49.0000     90.0000     88.0000
LEAD               .3400       .0120      4.0000       .1600       .0860       .2500 <     .0100       .4200
MAGNESIUM        29.0000     15.0000     27.0000     33.0000     20.0000     26.0000     25.0000     35.0000
MEPCURY            .0002 <     .0002       .0002 <     .0002       .0028       .0006 <     .0002       .0041
SELENIUM           .0020 <     .0040       .0020 <     .0010 <     .0040       .0030 <     .0020 <     .0010
SULFITE           0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SODIUM          190.0000    140.0000    180.0000     18.0000    150.0000    170.0000    210.0000    170.0000
TOTAL ELEM      399.4222    475.1512    683.1772    688.3562    604.4308    625.5026    775.2142    581.6551


POND D GROUND WELL 1

WELL DESIG          GWD1
DATE         780628.0000
REC NO.        8340.0000
PH                7.7000
ALKALINITY      120.0000
CHLORIDE        290.0000
COD              18.0000
COND           1600.0000
TDS             990.0000
TSS           11000.0000
SULFATE         290.0000
ARSENIC      <     .0040
BOPON              .5300
CALCIUM         110.0000
LEAD               .1600
MAGNESIUM        40.0000
MEPCURY            .0012
SELENIUM           .0010
SULFITE           0.0000
SODIUM          200.0000
TOTAL ELEM      930.6962
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POND D GROUND WELL 1--- AEROSPACE ---

WELL DESIG	GWD1	GWD1	GWD1	GWD1	GWD1	GWD1	GWD1	GWD1
DATE	741007.0000	741028.0000	750211.0000	751103.0000	760503.0000	770405.0000	780309.0000	780316.0000
REC NO.	8360.0000	8380.0000	8400.0000	8420.0000	8440.0000	8460.0000	8480.0000	8500.0000
PH	7.7000	7.4800	7.4900	7.0100	7.2700	7.1300	8.0400	7.7700
ALKALINITY	76.0000	0.0000	138.0000	60.0000	86.0000	68.0000	72.0000	46.0000
CHLORIDE	170.0000	210.0000	135.0000	440.0000	500.0000	360.0000	730.0000	600.0000
COD	25.0000	0.0000	40.0000	25.0000	0.0000	0.0000	0.0000	0.0000
COND	380.0000	660.0000	640.0000	1.1000	1.1000	1140.0000	1520.0000	1560.0000
TDS	696.0000	324.0000	372.0000	690.0000	642.0000	646.0000	1008.0000	1020.0000
TSS	0.0000	1010.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SULFATE	29.0000	29.0000	10.0000	15.0000	18.0000	50.0000	200.0000	210.0000
ARSENIC	.0040	.0040	.0050	.0060	.0130	< .0010	.0600	0.0000
BORON	.1000	.2000	1.0000	.9000	.5000	1.0000	< .5000	< .5000
CALCIUM	10.0000	20.0000	28.0000	32.0000	56.0000	55.0000	80.0000	80.0000
LEAD	.0500	.0130	.0400	< .0100	< .0100	.0350	.2000	0.0000
MAGNESIUM	7.4000	11.2000	17.0000	25.0000	26.0000	18.9000	40.0000	37.0000
MERCURY	.0010	.0013	.0003	.0003	.0006	< .0001	.0026	0.0000
SELENIUM	.0020	.0080	.0050	.0040	.0520	< .0006	.0004	0.0000
SULFITE	28.0000	.1000	.6000	.1000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	0.0000	149.0000	148.0000	142.0000	210.0000	225.0000
TOTAL ELEM	244.5570	270.5263	191.6503	662.0203	748.5756	626.9367	1260.7630	1152.5000

POND E SUPERNATE

WELL DESIG	PSE	PSE	PSE	PSE	PSE	PSE	PSE	PSE
DATE	750211.0000	750428.0000	750708.0000	750901.0000	751103.0000	760106.0000	760301.0000	760503.0000
REC NO.	8520.0000	8540.0000	8560.0000	8580.0000	8600.0000	8620.0000	8640.0000	8660.0000
PH	11.9000	10.2000	7.5000	7.9000	7.9000	7.6000	8.0000	7.6000
ALKALINITY	410.0000	34.0000	27.0000	26.0000	27.0000	32.0000	22.0000	32.0000
CHLORIDE	170.0000	110.0000	100.0000	88.0000	110.0000	40.0000	68.0000	42.0000
COD	6.0000	9.0000	7.0000	15.0000	14.0000	8.0000	14.0000	27.0000
COND	2800.0000	1600.0000	2000.0000	2500.0000	2600.0000	1200.0000	2300.0000	2400.0000
TDS	1300.0000	1200.0000	1700.0000	2200.0000	2400.0000	1200.0000	2200.0000	2300.0000
TSS	6.0000	12.0000	19.0000	46.0000	120.0000	26.0000	5.0000	7.0000
SULFATE	220.0000	390.0000	840.0000	1400.0000	1100.0000	850.0000	1100.0000	1400.0000
ARSENIC	< .0050	< .0050	.0100	.0100	.0050	< .0050	.0050	< .0050
BORON	.1100	.3300	.6600	.8000	.2500	0.0000	.2200	.2900
CALCIUM	19.0000	170.0000	260.0000	400.0000	360.0000	400.0000	500.0000	410.0000
LEAD	< .0100	.0360	.0110	.0170	.1000	< .0100	< .0100	< .0100
MAGNESIUM	.3000	1.0000	3.7000	3.3000	4.1000	4.5000	2.1000	5.8000
MERCURY	.0008	< .0002	< .0002	< .0002	< .0002	< .0002	< .0002	< .0002
SELENIUM	< .0020	.0030	< .0020	< .0020	< .0010	.0040	< .0040	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	140.0000	180.0000	190.0000	56.0000	170.0000	110.0000
TOTAL ELEM	409.4278	671.3742	1344.3832	2072.1292	1764.4562	1350.5192	1840.3392	1968.1072

POND E SUPERNATE

WELL DESIG	PSE	PSE	PSE	PSE	PSE	PSE	PSE
DATE	760706.0000	760914.0000	761109.0000	770223.0000	770505.0000	770707.0000	770926.0000
REC NO.	8680.0000	8700.0000	8720.0000	8740.0000	8760.0000	8780.0000	8800.0000
PH	7.3000	8.0000	8.7000	7.8000	6.8000	7.0000	7.3000
ALKALINITY	36.0000	39.0000	22.0000	34.0000	29.0000	32.0000	33.0000
CHLORIDE	22.0000	43.0000	90.0000	39.0000	16.0000	16.0000	42.0000
COD	13.0000	33.0000	14.0000	15.0000	14.0000	16.0000	34.0000
COND	1300.0000	2200.0000	2000.0000	1200.0000	1100.0000	1000.0000	1300.0000
TDS	1300.0000	2700.0000	2400.0000	1100.0000	1200.0000	1000.0000	1100.0000
TSS	14.0000	82.0000	6.0000	5.0000	6.0000	77.0000	38.0000
SULFATE	770.0000	2200.0000	1500.0000	870.0000	680.0000	0.0000	330.0000
ARSENIC	< .0050	< .0050	< .0020	.0040	.0090	.0050	.0040
BORON	.5900	1.2000	.6900	.5700	.7000	.6400	.7200
CALCIUM	300.0000	530.0000	660.0000	280.0000	270.0000	260.0000	220.0000
LEAD	.0410	.0320	< .0100	< .0100	< .0100	< .0100	.0120
MAGNESIUM	3.0000	4.9000	6.8000	4.0000	4.0000	3.8000	3.2000
MERCURY	< .0002	.0004	< .0002	.0002	< .0002	< .0002	< .0002
SELENIUM	.0010	.0010	.0030	.0020	.0030	.0020	< .0010
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	38.0000	59.0000	110.0000	48.0000	26.0000	21.0000	32.0000
TOTAL ELEM	1133.6372	2838.1384	2367.5052	1241.5862	996.7222	301.4572	627.9372

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POND E SUPERNATE    --- AEROSPACE ---

WELL DESIG        PSE           PSE           PSE           PSE           PSE           PSE
DATE       750211.0000   750707.0000   751103.0000   760503.0000   761109.0000   770505.0000
REC NO.      8820.0000     8840.0000     8860.0000     8880.0000     8900.0000     8920.0000
PH             11.7900        6.9500        7.2100        6.8600        7.1100        6.8000
ALKALINITY    536.0000       28.0000       74.0000       32.0000       20.0000       26.0000
CHLORIDE      365.0000      245.0000      170.0000      110.0000      175.0000      110.0000
COD            20.0000       80.0000       10.0000        0.0000        0.0000        0.0000
COND         2900.0000     1660.0000     2380.0000     2270.0000     2370.0000     1220.0000
TDS          1440.0000     1720.0000     2380.0000     2310.0000     2364.0000     1102.0000
TSS             0.0000        0.0000        0.0000        0.0000        0.0000        0.0000
SULFATE       250.0000     1000.0000     1375.0000     1400.0000     1425.0000      700.0000
ARSENIC          .0040         .0040         .0060         .0230         .0160         .0030
BORON            .4000         .7000         .8000        1.5000        2.0000        1.9500
CALCIUM        24.0000      260.0000       80.0000      450.0000      500.0000      270.0000
LEAD             .0500         .0500  <      .0200  <      .0100         .0350         .0750
MAGNESIUM      30.0000        3.3000        5.0000        7.0000        5.0000        3.2000
MERCURY         0.0000         .0001         .0002         .0007  <      .0001         .0004
SELENIUM         .0013         .0190         .0160         .0430  <      .0006         .0033
SULFITE          .2800         .1800         .4000        0.0000        0.0000        0.0000
SODIUM          0.0000      190.0000      195.0000      114.0000      102.0000       25.0000
TOTAL ELEM    669.7353     1699.2531     1826.2422     2082.5767     2209.0517     1110.2317
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POND E LEACHATE

WELL DESIG	LWE	LWE	LWE	LWE	LWE	LWE	LWE	LWE
DATE	750211.0000	750428.0000	750707.0000	750901.0000	751103.0000	760106.0000	760301.0000	760503.0000
REC NO.	8940.0000	8960.0000	8980.0000	9000.0000	9020.0000	9040.0000	9060.0000	9080.0000
PH	7.9000	11.1000	11.2000	10.7000	10.5000	9.5000	9.9000	8.2000
ALKALINITY	120.0000	490.0000	700.0000	550.0000	380.0000	190.0000	110.0000	110.0000
CHLORIDE	1000.0000	0.0000	650.0000	25.0000	320.0000	370.0000	490.0000	420.0000
COD	56.0000	320.0000	180.0000	150.0000	240.0000	110.0000	0.0000	110.0000
COND	4000.0000	0.0000	4600.0000	4000.0000	3700.0000	3300.0000	3700.0000	3800.0000
TDS	2400.0000	3400.0000	2900.0000	2700.0000	2700.0000	2700.0000	2800.0000	2400.0000
TSS	0.0000	14.0000	9300.0000	7600.0000	14.0000	980.0000	92.0000	1200.0000
SULFATE	300.0000	670.0000	370.0000	1100.0000	850.0000	1300.0000	1100.0000	1000.0000
ARSENIC	.0270	.1400	.1100	.0550	.0960	.0550	.0650	0.0000
BORON	.6800	.1400	< .1000	.8000	.3500	3.0000	.3000	.0500
CALCIUM	98.0000	13.0000	83.0000	83.0000	14.0000	49.0000	28.0000	0.0000
LEAD	.0480	.0200	.0550	.1400	< .0100	.6100	.0620	0.0000
MAGNESIUM	5.1000	.5000	23.0000	13.0000	.2000	3.5000	.9000	0.0000
MERCURY	.0005	.0013	.0033	.0012	.0008	.0047	.0014	.0028
SELENIUM	< .0020	.0460	< .0020	.0170	.0060	.0080	.0100	< .0040
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	0.0000	0.0000	750.0000	610.0000	630.0000	0.0000	0.0000	0.0000
TOTAL ELEM	1403.8575	683.8473	1876.2703	1832.0132	1814.6628	1726.1777	1619.3384	1420.0568

POND E LEACHATE

WELL DESIG	LWE	LWE	LWE	LWE	LWE	LWE	LWE	LWE
DATE	760706.0000	761109.0000	770215.0000	770505.0000	770707.0000	770926.0000	771108.0000	780316.0000
REC NO.	9100.0000	9120.0000	9140.0000	9160.0000	9180.0000	9200.0000	9220.0000	9240.0000
PH	7.6000	7.3000	7.9000	6.4000	7.2000	7.2000	7.8000	7.2000
ALKALINITY	60.0000	64.0000	53.0000	33.0000	44.0000	36.0000	54.0000	74.0000
CHLORIDE	350.0000	260.0000	190.0000	220.0000	180.0000	120.0000	180.0000	200.0000
COD	55.0000	25.0000	6.0000	17.0000	27.0000	26.0000	0.0000	260.0000
COND	3400.0000	3300.0000	3500.0000	3200.0000	3100.0000	3600.0000	4100.0000	4400.0000
TDS	2900.0000	3800.0000	3700.0000	3200.0000	3400.0000	3100.0000	3500.0000	3700.0000
TSS	150.0000	83.0000	98.0000	14.0000	340.0000	18.0000	41.0000	160.0000
SULFATE	1000.0000	0.0000	840.0000	2500.0000	2200.0000	1900.0000	2000.0000	1200.0000
ARSENIC	.0300	.0170	.0040	.0140	.0170	.0100	< .0040	.0220
BORON	.5500	0.0000	.5800	.4900	.6500	.7000	.7000	.3000
CALCIUM	100.0000	0.0000	500.0000	340.0000	410.0000	630.0000	0.0000	480.0000
LEAD	.0130	0.0000	< .0100	< .0100	< .0100	.0120	< .0100	.0780
MAGNESIUM	11.0000	0.0000	25.0000	14.0000	19.0000	13.0000	19.0000	28.0000
MERCURY	< .0002	.0004	< .0020	.0006	.0003	< .0002	< .0002	.0004
SELENIUM	.0080	0.0000	.0030	.0020	.0050	.0030	< .0010	< .0020
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	610.0000	140.0000	460.0000	420.0000	320.0000	280.0000	340.0000	430.0000
TOTAL ELEM	2071.6012	400.0174	2015.5990	3494.5166	3129.6823	2943.7252	2539.7152	2338.4024

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POND E LEACHATE     --- AEROSPACE ---

WELL DESIG          LWE         LWE         LWE         LWE         LWE         LWE         LWE         LWE
DATE        750319.0000 750707.0000 751103.0000 760121.0000 761109.0000 770302.0000 770505.0000 780316.0000
REC NO.       9260.0000   9280.0000   9300.0000   9320.0000   9340.0000   9360.0000   9380.0000   9400.0000
PH               8.8200     10.9600      9.7400      8.1000      7.5400      7.0300      6.8100      7.5200
ALKALINITY     162.0000    568.0000    253.0000     79.0000     71.4000     28.0000     26.0000      0.0000
CHLORIDE      1850.0000    740.0000    490.0000    520.0000    370.0000    250.0000    295.0000    195.0000
COD             90.0000    245.0000    115.0000     60.0000      0.0000      0.0000      0.0000      0.0000
COND          3900.0000   4160.0000   4000.0000   3330.0000   4180.0000   3730.0000   3550.0000   3910.0000
TDS           2720.0000   3200.0000   2690.0000   2640.0000   3750.0000   3410.0000   3164.0000   3884.0000
TSS              0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SULFATE        250.0000    800.0000    900.0000   1075.0000   1950.0000   2175.0000   1875.0000   2100.0000
ARSENIC           .0100       .0800       .0140       .0760       .0320       .0310       .0090      0.0000
BORON            1.6000       .6000       .6000       .5000      1.8000       .7000       .5000 <     .5000
CALCIUM         15.0000     20.0000 <   20.0000     30.0000    340.0000    390.0000    360.0000    460.0000
LEAD              .1300       .0500 <     .0100 <     .0100       .0350       .0550       .2200      0.0000
MAGNESIUM       30.0000       .5000      0.0000       .4000     22.0000     12.0000     11.0000     34.0000
MERCURY           .0005       .0003       .0009       .0007 <     .0001 <     .0001 <     .0001      0.0000
SELENIUM          .0120       .0430       .0180       .0050       .0013 <     .0006 <     .0006      0.0000
SULFITE           .2000       .3000     38.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SODIUM         970.0000    970.0000    580.0000    540.0000    560.0000    460.0000    395.0000    445.0000
TOTAL ELEM    3116.9525   2531.5733   2028.6429   2165.9917   3243.8684   3287.7867   2936.7297   3234.5000
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POND E GROUND WELL 1

WELL DESIG             GWE1           GWE1           GWE1           GWE1           GWE1           GWE1           GWE1           GWE1
DATE            750211.0000    750428.0000    750708.0000    750901.0000    751103.0000    760503.0000    760712.0000    770505.0000
REC NO.           9420.0000      9440.0000      9460.0000      9480.0000      9500.0000      9520.0000      9540.0000      9560.0000
PH                   6.8000         7.0000         7.0000         7.0000         7.2000         7.3000         7.6000         6.6000
ALKALINITY         220.0000       220.0000       230.0000       200.0000       210.0000       150.0000       130.0000        86.0000
CHLORIDE            55.0000        36.0000        55.0000        40.0000        85.0000        38.0000        41.0000        49.0000
COD                 25.0000        10.0000         9.0000         9.0000        47.0000        19.0000         9.0000        17.0000
COND               680.0000       630.0000       660.0000       580.0000       640.0000       640.0000       470.0000       430.0000
TDS                420.0000       390.0000       560.0000       590.0000       410.0000       420.0000       370.0000       320.0000
TSS                  0.0000        90.0000      4600.0000     24000.0000         0.0000       140.0000      1600.0000       920.0000
SULFATE             36.0000        37.0000        86.0000       460.0000        67.0000       150.0000        77.0000        80.0000
ARSENIC      <        .0050 <        .0050          .0050 <        .0050          .0050          .0150 <        .0050          .0120
BORON                 .2400 <        .1000          .1400          .2000          .1800          .0300        39.0000          .3000
CALCIUM             32.0000        26.0000        49.0000        85.0000        16.0000        65.0000        24.0000        25.0000
LEAD                  .0250          .0220          .5100          .2500          .4000          .1400          .4600          .0600
MAGNESIUM            9.4000         9.8000        19.0000        26.0000        98 0000         7.7000         9.8000         8.0000
MERCURY      <        .0002          .0040          .0013 <        .0002 <        .0002 <        .0002 <        .0002          .0009
SELENIUM     <        .0020          .0020          .0030 <        .0020 <        .0010          .0060 <        .0010          .0020
SULFITE              0.0000         0.0000         0.0000         0.0000         0.0000         0.0000         0.0000         0.0000
SODIUM               0.0000         0.0000        92.0000        89.0000       120.0000        78.0000        79.0000        66.0000
TOTAL ELEM         132.6722       108.9330       301.6593       700.4572       386.7862       338.8912       270.2662       228.3749
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POND E GROUND WELL 1

WELL DESIG             GWE1           GWE1           GWE1           GWE1
DATE            780105.0000    780316.0000    780511.0000    780628.0000
REC NO.           9580.0000      9600.0000      9620.0000      9640.0000
PH                   6.8000         7.0000         7.4000         7.6000
ALKALINITY         110.0000        95.0000       140.0000       160.0000
CHLORIDE            42.0000        60.0000        56.0000        80.0000
COD                110.0000       120.0000         9.0000        11.0000
COND               300.0000       580.0000       700.0000       580.0000
TDS                450.0000       320.0000       550.0000       600.0000
TSS               7400.0000      1100.0000       410.0000     27000.0000
SULFATE             59.0000        42.0000       110.0000        33.0000
ARSENIC               .0300 <        .0020          .0310 <        .0040
BORON                 .1700          .1000          .1400          .1400
CALCIUM             28.0000        88.0000        61.0000        57.0000
LEAD                  .1100          .0620          .0280          .0900
MAGNESIUM           11.0000        18.0000        12.0000        14.0000
MERCURY               .0012 <        .0002          .0003          .0017
SELENIUM     <        .0020 <        .0020          .0030 <        .0010
SULFITE              0.0000         0.0000         0.0000         0.0000
SODIUM              70.0000        50.0000        73.0000        71.0000
TOTAL ELEM         210.3132       258.1662       312.2023       255.2367
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POND E GROUND WELL 1--- AEROSPACE ---

WELL DESIG          GWE1        GWE1        GWE1        GWE1        GWE1        GWE1        GWE1
DATE         750211.0000 750707.0000 751103.0000 760503.0000 770505.0000 780309.0000 780316.0000
REC NO.        9660.0000   9680.0000   9700.0000   9720.0000   9740.0000   9760.0000   9780.0000
PH                7.3400      7.2500      7.3700      7.7800      7.2100      7.9900      7.9900
ALKALINITY      223.0000    217.0000    177.0000      0.0000     87.0000     79.0000    106.0000
CHLORIDE        115.0000     71.0000     72.0000     62.0000     88.0000     67.0000     54.0000
COD              50.0000      0.0000     10.0000      0.0000      0.0000      0.0000      0.0000
COND            640.0000    550.0000   2440.0000    560.0000    420.0000    413.0000    617.0000
TDS             416.0000    440.0000    380.0000    384.0000    270.0000    316.0000    462.0000
TSS               0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SULFATE          28.0000     70.0000     55.0000     80.0000     69.0000     60.0000    125.0000
ARSENIC            .0050       .0040       .0100      0.0000       .0080       .0700      0.0000
BORON              .1000       .2000       .7000      1.0000       .6000 <     .5000      4.2000
CALCIUM          32.0000     13.0000      8.0000     42.0000     23.0000     13.0000     45.0000
LEAD               .0400       .0500 <     .0200 <     .0100       .0500       .2400      0.0000
MAGNESIUM        15.0000     11.7000     12.0000     10.0000      5.6000     12.0000     17.0000
MERCURY            .0003       .0004       .0003      0.0000       .0001       .0007      0.0000
SELENIUM           .0050       .0005       .0020      0.0000       .0027       .0010      0.0000
SULFITE            .3000       .6400       .3000      0.0000      0.0000      0.0000      0.0000
SODIUM            0.0000      0.0000     99.0000     83.0000     65.0000     65.0000     60.0000
TOTAL ELEM      190.4503    166.5949    247.0323    278.0100    251.2608    217.8117    305.2000
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POND E GROUND WELL 2

WELL DESIG          GWE2          GWE2          GWE2          GWE2          GWE2          GWE2          GWE2          GWE2
DATE         740805.0000   740903.0000   741007.0000   741028.0000   741104.0000   750211.0000   750428.0000   750708.0000
REC NO.        9800.0000     9820.0000     9840.0000     9860.0000     9880.0000     9900.0000     9920.0000     9940.0000
PH                7.0000        7.2000        7.2000        0.0000        7.0000        6.9000        6.8000        6.8000
ALKALINITY      110.0000       94.0000      170.0000        0.0000      100.0000      230.0000      160.0000      150.0000
CHLORIDE         50.0000       28.0000       66.0000        0.0000       29.0000       63.0000       46.0000       52.0000
COD               0.0000        0.0000        0.0000        0.0000        0.0000      860.0000       31.0000      120.0000
COND              0.0000        0.0000        0.0000        0.0000      490.0000     1000.0000      590.0000      600.0000
TDS             400.0000      220.0000      370.0000        0.0000      320.0000      460.0000      350.0000      480.0000
TSS            5400.0000        0.0000      180.0000        0.0000      190.0000        0.0000       25.0000     7500.0000
SULFATE          48.0000       26.0000       40.0000        0.0000       69.0000       52.0000       50.0000       89.0000
ARSENIC            .0230  <      .0050  <      .0050  <      .0050  <      .0050  <      .0050  <      .0050  <      .0050
BORON     <        .1000  <      .1000  <      .1000  <      .1000  <      .1000         .5000         .1500         .1800
CALCIUM          31.0000       22.0000       23.0000        0.0000       35.0000       72.0000       34.0000       62.0000
LEAD               .0950         .0160         .0100        0.0000         .0100         .8900  <      .0100         .2500
MAGNESIUM        24.0000        5.6000        8.3000        0.0000        8.8000       12.0000        8.5000       16.0000
MERCURY   <        .0002  <      .0002  <      .0002        0.0000         .0002         .0005         .0002  <      .0002
SELENIUM  <        .0020  <      .0020  <      .0020  <      .0020  <      .0020  <      .0020  <      .0020  <      .0020
SULFITE           0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000
SODIUM            0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000
TOTAL ELEM      153.2202       81.7232      137.4172         .1070      141.9172      200.3975      138.6672      219.4372
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POND E GROUND WELL 2

WELL DESIG          GWE2          GWE2          GWE2          GWE2          GWE2          GWE2
DATE         750901.0000   760503.0000   760712.0000   780323.0000   780511.0000   780628.0000
REC NO.        9960.0000     9980.0000    10000.0000    10020.0000    10040.0000    10060.0000
PH                7.0000        7.3000        7.8000        7.1000        7.2000        7.6000
ALKALINITY      120.0000      200.0000      250.0000      180.0000      170.0000      170.0000
CHLORIDE         32.0000       28.0000       38.0000       21.0000       20.0000       30.0000
COD              37.0000        0.0000       37.0000      190.0000       40.0000       19.0000
COND            480.0000      640.0000      570.0000      500.0000      500.0000      540.0000
TDS             340.0000      430.0000      390.0000      350.0000      370.0000      400.0000
TSS           29000.0000      550.0000      150.0000     3400.0000     1500.0000      180.0000
SULFATE         150.0000      100.0000       15.0000       43.0000       60.0000       58.0000
ARSENIC            .0150  <      .0050  <      .0050         .0060         .0220         .0220
BORON              .8000         .1000         .3800         .1500         .1500         .2800
CALCIUM          71.0000       55.0000       46.0000       71.0000       69.0000       79.0000
LEAD               .0850         .0210         .1700         .2800         .0920         .2000
MAGNESIUM        11.0000        8.8000        8.4000        7.1000        8.8000        8.1000
MERCURY   <        .0002  <      .0002  <      .0002  <      .0002         .0010         .0050
SELENIUM  <        .0020  <      .0040         .0010  <      .0020         .0020  <      .0010
SULFITE           0.0000        0.0000        0.0000        0.0000        0.0000        0.0000
SODIUM            0.0000        0.0000        0.0000       41.0000       29.0000       37.0000
TOTAL ELEM      264.9022      191.9302      107.9562      183.5382      187.0670      212.6080
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POND E GROUND WELL 2--- AEROSPACE ---

WELL DESIG          GWE2        GWE2        GWE2        GWE2
DATE         741028.0000 750428.0000 750708.0000 760503.0000
REC NO.       10080.0000  10100.0000  10120.0000  10140.0000
PH                8.3600      7.6300      6.8900      7.5100
ALKALINITY      181.0000      0.0000    176.0000      0.0000
CHLORIDE         84.0000    125.0000     64.0000     62.0000
COD              50.0000      0.0000     15.0000      0.0000
COND            610.0000    640.0000    500.0000    620.0000
TDS             384.0000    544.0000    400.0000    522.0000
TSS               0.0000      0.0000      0.0000      0.0000
SULFATE          37.0000     56.0000    110.0000    110.0000
ARSENIC            .0050       .0050       .0040      0.0000
BORON              .3000       .6000       .2000      1.0000
CALCIUM          20.0000     20.0000     37.0000     63.0000
LEAD               .0300       .0900       .0500 <     .0100
MAGNESIUM        15.0000     12.0000      7.5000     11.0000
MERCURY           0.0000      0.0000      0.0000      0.0000
SELENIUM           .0040       .0030       .0010      0.0000
SULFITE            .3000       .7000       .4400      0.0000
SODIUM           79.0000      0.0000      0.0000     62.0000
TOTAL ELEM      235.6390    214.3980    219.1950    309.0100
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POND F UNDERDRAIN

WELL DESIG          UDF         UDF         UDF         UDF         UDF         UDF
DATE        770505.0000 770713.0000 770926.0000 771104.0000 780316.0000 780511.0000
REC NO.      10160.0000  10180.0000  10200.0000  10220.0000  10240.0000  10260.0000
PH              10.5000      8.5000      9.0000      7.9000      0.0000      7.7000
ALKALINITY      82.0000     40.0000     43.0000     44.0000      0.0000    280.0000
CHLORIDE       890.0000    910.0000    720.0000   1700.0000      0.0000     50.0000
COD             33.0000     27.0000     17.0000     15.0000     25.0000     15.0000
COND          3400.0000   4800.0000   4200.0000   5300.0000      0.0000   1500.0000
TDS           4100.0000   4000.0000   3700.0000   4100.0000      0.0000    980.0000
TSS             12.0000     17.0000     31.0000     37.0000      0.0000     25.0000
SULFATE       1400.0000   1200.0000   1400.0000   1500.0000      0.0000    380.0000
ARSENIC           .0070  <    .0040       .0030       .0040       .0040       .0060
BORON            9.9000      7.0000     16.0000     12.0000      0.0000      1.2000
CALCIUM        750.0000   1100.0000   1200.0000   1600.0000    290.0000    200.0000
LEAD        <     .0100  <    .0100  <    .0100  <    .0100  <    .0100  <    .0100
MAGNESIUM        2.0000      1.4000     19.0000      6.7000     30.0000     33.0000
MERCURY     <     .0002       .0010  <    .0002  <    .0002  <    .0002       .0006
SELENIUM          .0270       .0340       .0240       .0240  <    .0020  <    .0010
SULFITE          0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SODIUM          50.0000     64.0000     41.0000     50.0000     97.0000     92.0000
TOTAL ELEM    3101.9442   3282.4490   3396.0372   4868.7382    417.0162    756.2176


POND F UNDERDRAIN   --- AEROSPACE ---

WELL DESIG          UDF         UDF         UDF
DATE        770505.0000 780309.0000 780316.0000
REC NO.      10280.0000  10300.0000  10320.0000
PH               9.9200      7.7100      7.8100
ALKALINITY      44.0000    200.0000     60.0000
CHLORIDE       980.0000    250.0000    140.0000
COD              0.0000      0.0000      0.0000
COND          4130.0000   1480.0000   1820.0000
TDS           3342.0000   1182.0000   1848.0000
TSS              0.0000      0.0000      0.0000
SULFATE       1225.0000    430.0000   1000.0000
ARSENIC     <     .0010       .0080      0.0000
BORON            9.0000      1.3000      4.2000
CALCIUM        940.0000    200.0000    360.0000
LEAD              .3200       .2400      0.0000
MAGNESIUM        1.8000     52.0000     50.0000
MERCURY     <     .0001  <    .0001      0.0000
SELENIUM    <     .0006       .0001      0.0000
SULFITE          0.0000      0.0000      0.0000
SODIUM          51.0000     90.0000      8.9000
TOTAL ELEM    3207.1217   1023.5482   1563.1000
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POND F GROUND WELL 1


WELL DESIG          GWF1         GWF1         GWF1         GWF1         GWF1         GWF1
DATE         770505.0000  770707.0000  771216.0000  780316.0000  780511.0000  780628.0000
REC NO.       10340.0000   10360.0000   10380.0000   10400.0000   10420.0000   10440.0000
PH                6.6000       7.8000       7.1000       6.7000       6.7000       7.5000
ALKALINITY      160.0000     140.0000     130.0000     130.0000     120.0000     110.0000
CHLORIDE         46.0000      54.0000      42.0000      64.0000     110.0000     120.0000
COD              14.0000      16.0000      18.0000       5.0000       5.0000       7.0000
COND            450.0000     430.0000     440.0000     490.0000     700.0000     690.0000
TDS             290.0000     250.0000     240.0000     280.0000     440.0000     390.0000
TSS              81.0000      13.0000     870.0000     420.0000    1200.0000    1600.0000
SULFATE          15.0000      32.0000  <    2.0000       8.0000      18.0000      12.0000
ARSENIC            .0030  <     .0020        .0170  <     .0040        .0190  <     .0040
BORON              .1300        .0400        .0700        .0400        .0600        .1600
CALCIUM          43.0000      42.0000      33.0000      38.0000      57.0000      48.0000
LEAD               .0250  <     .0100        .3800        .0110        .0350        .0700
MAGNESIUM        14.0000       9.5000      14.0000      12.0000      22.0000      19.0000
MERCURY     <      .0002  <     .0002        .0025  <     .0002        .0006        .0006
SELENIUM           .0090  <     .0020  <     .0020        .0020        .0020        .0020
SULFITE           0.0000       0.0000       0.0000       0.0000       0.0000       0.0000
SODIUM           43.0000      35.0000      33.0000      33.0000      60.0000      43.0000
TOTAL ELEM      161.1672     172.5542     124.4715     155.0572     267.1166     242.2366


POND F GROUND WELL 1--- AEROSPACE ---


WELL DESIG          GWF1         GWF1         GWF1
DATE         770505.0000  780309.0000  780316.0000
REC NO.       10460.0000   10480.0000   10500.0000
PH                7.1800       8.0000       8.1900
ALKALINITY      158.0000     120.0000     116.0000
CHLORIDE         70.0000     105.0000     100.0000
COD               0.0000       0.0000       0.0000
COND            440.0000     405.0000     413.0000
TDS             250.0000     258.0000     256.0000
TSS               0.0000       0.0000       0.0000
SULFATE          14.0000      10.0000      10.0000
ARSENIC            .0140        .0080       0.0000
BORON             1.5000  <     .5000       2.8000
CALCIUM          40.0000      31.0000      27.0000
LEAD               .0450        .1600       0.0000
MAGNESIUM        10.9000      13.0000      13.0000
MERCURY     <      .0001  <     .0001       0.0000
SELENIUM    <      .0006        .0001       0.0000
SULFITE           0.0000       0.0000       0.0000
SODIUM           41.0000      40.0000      35.0000
TOTAL ELEM      177.4597     199.6682     187.8000
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POND F GROUND WELL 2

WELL DESIG          GWF2          GWF2          GWF2          GWF2          GWF2          GWF2          GWF2          GWF2
DATE         770505.0000   770707.0000   770926.0000   771104.0000   771216.0000   780316.0000   780511.0000   780628.0000
REC NO.       10520.0000    10540.0000    10560.0000    10580.0000    10600.0000    10620.0000    10640.0000    10660.0000
PH               7.1000        7.5000        7.6000        7.5000        7.4000        7.1000        7.2000        7.8000
ALKALINITY     160.0000      280.0000      280.0000      290.0000      280.0000      240.0000      270.0000      270.0000
CHLORIDE        22.0000       17.0000       30.0000       15.0000       15.0000       12.0000       14.0000       15.0000
COD             34.0000       11.0000       21.0000       13.0000       50.0000        9.0000        7.0000        9.0000
COND           600.0000      630.0000      700.0000      700.0000      710.0000      610.0000      680.0000      690.0000
TDS            410.0000      470.0000      450.0000      460.0000      500.0000      390.0000      450.0000      430.0000
TSS             33.0000        2.0000       26.0000       19.0000     1900.0000       26.0000       25.0000      500.0000
SULFATE         58.0000       83.0000       62.0000       68.0000       72.0000       48.0000       68.0000       76.0000
ARSENIC           .0030         .0030         .0040   <     .0040         .0040   <     .0020   <     .0040   <     .0040
BORON             .3600         .0400         .1400         .1200         .0800         .0200         .2800         .1800
CALCIUM         46.0000       29.0000       36.0000       28.0000       28.0000       20.0000       28.0000       28.0000
LEAD              .0120   <     .0100         .0260         .0440         .3800         .0160   <     .0100         .0760
MAGNESIUM       13.0000       14.0000        9.8000       12.0000       15.0000        9.1000       11.0000       13.0000
MERCURY     <     .0002   <     .0002         .0021         .0009         .0009   <     .0002         .0005         .0007
SELENIUM    <     .0020   <     .0010   <     .0010   <     .0010   <     .0020   <     .0020   <     .0010   <     .0010
SULFITE          0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000
SODIUM         110.0000      120.0000       13.0000      130.0000      140.0000      110.0000      110.0000      130.0000
TOTAL ELEM     249.3772      263.0542      150.9731      253.1699      270.4669      199.1402      231.2955      262.2617


POND F GROUND WELL 2--- AEROSPACE ---

WELL DESIG          GWF2          GWF2          GWF2
DATE         770505.0000   780309.0000   780316.0000
REC NO.       10680.0000    10700.0000    10720.0000
PH               7.5700        8.0200        8.4000
ALKALINITY     283.0000      245.0000      127.0000
CHLORIDE        75.0000       15.0000       20.0000
COD              0.0000        0.0000        0.0000
COND           510.0000      556.0000      543.0000
TDS            380.0000      422.0000      360.0000
TSS              0.0000        0.0000        0.0000
SULFATE         64.0000       60.0000       54.0000
ARSENIC           .0310   <     .0040        0.0000
BORON             .3000   <     .5000        1.7000
CALCIUM         27.0000       19.0000       15.0000
LEAD              .0500         .2000        0.0000
MAGNESIUM       10.7000       11.0000       11.0000
MERCURY     <     .0001         .0009        0.0000
SELENIUM          .0033         .0001        0.0000
SULFITE          0.0000        0.0000        0.0000
SODIUM          96.0000      110.0000      107.0000
TOTAL ELEM     273.0844      215.7050      208.7000
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POND G UNDERDRAIN

WELL DESIG          UDG           UDG           UDG           UDG           UDG           UDG
DATE        770505.0000   770707.0000   770926.0000   780316.0000   780511.0000   780628.0000
REC NO.      10740.0000    10760.0000    10780.0000    10800.0000    10820.0000    10840.0000
PH               6.8000        7.3000        7.3000        0.0000        6.9000        7.4000
ALKALINITY     170.0000       99.0000       66.0000        0.0000      120.0000      270.0000
CHLORIDE       280.0000      700.0000      290.0000        0.0000      300.0000      300.0000
COD             15.0000       14.0000       24.0000       10.0000        5.0000       18.0000
COND          2000.0000     3700.0000     3200.0000        0.0000     3200.0000     3000.0000
TDS           2100.0000     4300.0000     2900.0000        0.0000     2600.0000     2300.0000
TSS              4.0000        9.0000        5.0000        0.0000      220.0000      390.0000
SULFATE        890.0000     1900.0000     1400.0000        0.0000     1300.0000     1000.0000
ARSENIC     <     .0020   <     .0040   <     .0020   <     .0040         .0040         .0100
BORON            6.8000       23.0000       18.0000        0.0000        7.0000        0.0000
CALCIUM        260.0000      660.0000      880.0000      470.0000      590.0000      640.0000
LEAD              .0100   <     .0100   <     .0100   <     .0100         .0450         .1000
MAGNESIUM      120.0000      250.0000      130.0000       30.0000      120.0000      120.0000
MERCURY           .0006   <     .0002   <     .0004   <     .0002         .0003         .0005
SELENIUM    <     .0100         .0420         .0190         .0070         .0050         .0140
SULFITE          0.0000        0.0000        0.0000        0.0000        0.0000        0.0000
SODIUM          30.0000       31.0000       18.0000        6.5000       20.0000       23.0000
TOTAL ELEM    1586.8226     3564.0562     2736.0314      506.5212     2337.0543     2083.1245
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POND G UNDERDRAIN   --- AEROSPACE ---

WELL DESIG          UDG           UDG           UDG
DATE        770505.0000   780309.0000   780316.0000
REC NO.      10860.0000    10880.0000    10900.0000
PH               7.3000        7.4600        7.6400
ALKALINITY     175.0000       49.6000      280.0000
CHLORIDE       385.0000      930.0000      900.0000
COD              0.0000        0.0000        0.0000
COND          2250.0000     3450.0000     3360.0000
TDS           1720.0000     3116.0000     2664.0000
TSS              0.0000        0.0000        0.0000
SULFATE        900.0000     1475.0000      876.0000
ARSENIC           .0140         .0080        0.0000
BORON            6.7000       23.0000       32.0000
CALCIUM        390.0000      600.0000      410.0000
LEAD              .1900         .6000        0.0000
MAGNESIUM      103.0000      217.0000      249.0000
MERCURY     <     .0001         .0010        0.0000
SELENIUM          .0017         .0004        0.0000
SULFITE          0.0000        0.0000        0.0000
SODIUM          29.0000       25.0000       52.0000
TOTAL ELEM    1813.9058     3270.6094     2519.0000
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POND G GROUND WELL 1


WELL DESIG          GWG1          GWG1          GWG1          GWG1          GWG1          GWG1          GWG1
DATE         770505.0000   770707.0000   771104.0000   771216.0000   780316.0000   780511.0000   780628.0000
REC NO.       10920.0000    10940.0000    10960.0000    10980.0000    11000.0000    11020.0000    11040.0000
PH                6.0000        6.8000        6.6000        6.2000        6.1000        6.1000        6.7000
ALKALINITY       22.0000       23.0000       22.0000       26.0000       20.0000       18.0000       24.0000
CHLORIDE         12.0000       16.0000       12.0000       15.0000       12.0000       13.0000       16.0000
COD               4.0000        4.0000        4.0000       48.0000        3.0000        1.0000        3.0000
COND            170.0000      140.0000      170.0000      200.0000      180.0000      180.0000     1600.0000
TDS             130.0000      150.0000      190.0000      340.0000      180.0000      210.0000      280.0000
TSS             160.0000       70.0000      300.0000     2700.0000     1400.0000     1400.0000     1900.0000
SULFATE          41.0000       28.0000       28.0000        7.0000       52.0000       40.0000       20.0000
ARSENIC            .0040         .0020 <       .0040 <       .0020 <       .0020         .0160 <       .0040
BORON              .1500         .0400         .0400         .0500         .1300         .1200         .1100
CALCIUM          14.0000       10.0000       14.0000       11.0000       12.0000       13.0000       14.0000
LEAD               .0110         .0100         .0270         .0720         .0110         .0150         .0490
MAGNESIUM         5.2000        4.2000        4.3000        4.6000        4.5000        5.6000        5.6000
MERCURY    <       .0002         .0002 <       .0002         .0004 <       .0002 <       .0002         .0011
SELENIUM           .0080 <       .0010         .0010 <       .0020 <       .0020 <       .0010 <       .0010
SULFITE           0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000
SODIUM           14.0000       12.0000       13.0000       14.0000       11.0000       11.0000       12.0000
TOTAL ELEM       86.3732       70.2532       71.3722       51.7264       91.6452       82.7522       67.7651
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POND G GROUND WELL 1--- AEROSPACE ---


WELL DESIG          GWG1          GWG1          GWG1
DATE         770505.0000   780309.0000   780316.0000
REC NO.       11060.0000    11080.0000    11100.0000
PH                6.8000        7.5600        7.8100
ALKALINITY       20.0000        0.0000       13.0000
CHLORIDE         38.0000       15.0000       11.0000
COD               0.0000        0.0000        0.0000
COND            140.0000      146.0000      154.0000
TDS             116.0000      156.0000      120.0000
TSS               0.0000        0.0000        0.0000
SULFATE          36.0000       31.0000       30.0000
ARSENIC            .0050 <       .0040        0.0000
BORON      <       .0500 <       .5000        1.6000
CALCIUM           8.0000        6.8000        7.0000
LEAD               .0500         .2000        0.0000
MAGNESIUM         3.5000        5.0000        5.1000
MERCURY    <       .0001         .0010        0.0000
SELENIUM           .0020         .0001        0.0000
SULFITE           0.0000        0.0000        0.0000
SODIUM           13.0000       11.0000       11.0000
TOTAL ELEM       98.6071       69.5051       65.7000
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POND G GROUND WELL 2

WELL DESIG         GWG2        GWG2        GWG2        GWG2        GWG2        GWG2        GWG2        GWG2
DATE        760914.0000 761115.0000 770505.0000 770707.0000 771216.0000 780316.0000 780511.0000 780628.0000
REC NO.      11120.0000  11140.0000  11160.0000  11180.0000  11200.0000  11220.0000  11240.0000  11260.0000
PH               6.7000      6.3000      7.2000      7.2000      6.7000      6.7000      6.7000      7.3000
ALKALINITY      94.0000     34.0000     56.0000     62.0000     70.0000     48.0000     80.0000     84.0000
CHLORIDE       120.0000     45.0000    220.0000    200.0000    220.0000    270.0000    280.0000    330.0000
COD             12.0000      0.0000     14.0000     18.0000     38.0000     12.0000     40.0000     18.0000
COND           760.0000    630.0000    900.0000    790.0000    930.0000   1100.0000   1300.0000   1500.0000
TDS            580.0000    530.0000    610.0000    590.0000    580.0000    650.0000   1100.0000    970.0000
TSS            920.0000    590.0000    110.0000    370.0000  30000.0000    100.0000   9800.0000   4700.0000
SULFATE        200.0000    280.0000    140.0000    100.0000     55.0000     46.0000     58.0000     19.0000
ARSENIC      <    .0050  <    .0020       .0180       .0070       .0080       .0460       .0820       .0280
BORON             .2200       .2400       .2200       .1500       .1100       .1200       .3800       .6000
CALCIUM         58.0000     50.0000     81.0000     72.0000    100.0000     51.0000     91.0000     79.0000
LEAD              .0340       .0500       .0200       .0100       .1400       .0170       .0450       .0420
MAGNESIUM        5.7000     22.0000     30.0000     28.0000     40.0000     13.0000     35.0000     27.0000
MERCURY      <    .0002       .0007  <    .0002  <    .0002       .0008  <    .0002       .0006       .0002
SELENIUM          .0010  <    .0010  <    .0020       .0010  <    .0020  <    .0020       .0030       .0070
SULFITE          0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SODIUM          86.0000     88.0000     85.0000     80.0000     78.0000    100.0000    120.0000    140.0000
TOTAL ELEM     469.9602    485.2937    556.2602    480.1682    493.2608    480.1852    584.5106    595.6772


POND G GROUND WELL 2--- AEROSPACE ---

WELL DESIG         GWG2        GWG2        GWG2        GWG2
DATE        761115.0000 770505.0000 780309.0000 780316.0000
REC NO.      11280.0000  11300.0000  11320.0000  11340.0000
PH               7.3700      7.2900      7.7000      7.7200
ALKALINITY      30.0000     57.4000     46.0000     40.6000
CHLORIDE        92.0000    255.0000    180.0000    400.0000
COD              0.0000      0.0000      0.0000      0.0000
COND           680.0000    920.0000    943.0000    926.0000
TDS            446.0000    556.0000    574.0000    544.0000
TSS              0.0000      0.0000      0.0000      0.0000
SULFATE        240.0000    140.0000     64.0000     68.0000
ARSENIC      <    .0010       .0050  <    .0040      0.0000
BORON            1.6000      1.2000  <    .5000      3.0000
CALCIUM         48.0000     73.0000     59.0000     53.0000
LEAD              .0300       .0500       .2000      0.0000
MAGNESIUM       17.5000     25.9000     31.0000     26.0000
MERCURY      <    .0001  <    .0001       .0015      0.0000
SELENIUM     <    .0006       .0040       .0001      0.0000
SULFITE          0.0000      0.0000      0.0000      0.0000
SODIUM          80.0000     85.0000    100.0000    100.0000
TOTAL ELEM     479.1317    580.1591    434.7056    650.0000
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POND H RUNOFF

WELL DESIG         PRH         PRH         PRH
DATE       771122.0000 771201.0000 771220.0000
REC NO.     11360.0000  11380.0000  11400.0000
PH              7.6000      7.3000      7.7000
ALKALINITY     36.0000   1200.0000    490.0000
CHLORIDE      760.0000     44.0000    100.0000
COD            12.0000     16.0000     12.0000
COND         3200.0000   2400.0000   2400.0000
TDS          3200.0000   2500.0000   2500.0000
TSS            13.0000   2300.0000   2500.0000
SULFATE      1500.0000   1500.0000   1500.0000
ARSENIC          .0020       .0880       .0780
BORON          30.0000      3.9000      6.6000
CALCIUM       820.0000    780.0000    760.0000
LEAD             .0100       .0270      0.0000
MAGNESIUM     140.0000     39.0000     31.0000
MERCURY          .0002       .0150       .0012
SELENIUM         .0010       .0550       .0780
SULFITE         0.0000      0.0000      0.0000
SODIUM         14.0000      4.5000      4.0000
TOTAL ELEM   3264.0132   2371.5850   2401.7572
```

```
POND H RUNOFF        --- AEROSPACE ---

WELL DESIG         PRH         PRH           PRH         PRH         PRH           PRH           PRH         PRH
DATE       771122.0000 771214.0000   771220.0000 780314.0000 780323.0000   780404.0000   780420.0000 780425.0000
REC NO.     11420.0000  11440.0000    11460.0000  11480.0000  11500.0000    11520.0000    11540.0000  11560.0000
PH              7.5900      7.3000        7.5300      0.0000      0.0000        0.0000        0.0000      0.0000
ALKALINITY     32.0000     56.0000       22.0000     58.0000     54.8000       63.2000       41.0000     65.4000
CHLORIDE      390.0000    135.0000      175.0000    500.0000     45.0000        7.0000       13.0000     27.0000
COD             0.0000      0.0000        0.0000      0.0000      0.0000        0.0000        0.0000      0.0000
COND         2860.0000   2060.0000     2160.0000   2600.0000   2000.0000     1870.0000     1980.0000   1980.0000
TDS          2900.0000   2350.0000     2397.0000   2934.0000   2220.0000     2069.0000     2216.0000   2156.0000
TSS             0.0000      0.0000        0.0000      3.6000     14.4000       50.4000       11.6000    309.4000
SULFATE      1625.0000   1500.0000     1525.0000   1475.0000   1475.0000     1275.0000     1450.0000   1325.0000
ARSENIC          .0160       .0190   <     .0100       .0330       .0250         .0250         .0250       .0330
BORON          20.0000     80.0000       11.0000     27.0000     10.0000        1.3000   <     .5000      1.7000
CALCIUM       660.0000    570.0000      610.0000    630.0000    550.0000      520.0000      550.0000    580.0000
LEAD             .1100       .0900         .0900       .3000       .4000   <     .2000         .4000       .3000
MAGNESIUM     113.0000     27.0000       24.0000    159.0000     30.1000       14.8000       13.1000     12.7000
MERCURY          .0030       .0040         .0020       .0008       .0027         .0011         .0019       .0007
SELENIUM         .0030       .0220         .0100       .0006       .0008         .0001         .0004       .0001
SULFITE         0.0000      0.0000        0.0000      0.0000      0.0000        0.0000        0.0000      0.0000
SODIUM         13.0000      4.0000        3.8000     13.0000      3.6000        3.5000        2.4000      2.6000
TOTAL ELEM   2821.1320   2316.1350     2348.9120   2804.3344   2114.1285     1821.8262     2029.4273   1949.3338
```

```
POND H RUNOFF        --- AEROSPACE ---

WELL DESIG          PRH          PRH          PRH
DATE        780516.0000  780523.0000  780628.0000
REC NO.      11580.0000   11600.0000   11620.0000
PH               0.0000       0.0000       0.0000
ALKALINITY      46.4000      44.0000     122.4000
CHLORIDE         5.6000       7.0000      90.0000
COD              0.0000       0.0000       0.0000
COND          1920.0000    1960.0000    1940.0000
TDS           2134.0000    2242.0000    2653.0000
TSS              4.8000       8.2000      64.6000
SULFATE       1325.0000    1450.0000    1500.0000
ARSENIC          0.0000        .0160        .0250
BORON             .7000       1.4000       9.0000
CALCIUM        570.0000     600.0000     700.0000
LEAD             0.0000        .2800  <     .2000
MAGNESIUM       11.4000       5.1000      36.2000
MERCURY          0.0000        .0013        .0010
SELENIUM         0.0000        .0003        .0001
SULFITE          0.0000       0.0000       0.0000
SODIUM           2.6000        .9000      11.1000
TOTAL ELEM    1915.3000    2064.6976    2346.5261
```

POND H UNDERDRAIN

WELL DESIG	UDH	UDH	UDH	UDH	UDH	UDH	UDH	UDH
DATE	770819.0000	770820.0000	770821.0000	770822.0000	770823.0000	770824.0000	770826.0000	770828.0000
REC NO.	11640.0000	11660.0000	11680.0000	11700.0000	11720.0000	11740.0000	11760.0000	11780.0000
PH	7.1000	7.0000	7.0000	7.0000	7.0000	7.1000	7.1000	7.1000
ALKALINITY	38.0000	54.0000	48.0000	52.0000	54.0000	54.0000	54.0000	54.0000
CHLORIDE	2800.0000	3200.0000	3200.0000	3300.0000	3400.0000	3300.0000	2800.0000	2600.0000
COD	120.0000	140.0000	120.0000	140.0000	120.0000	130.0000	140.0000	140.0000
COND	10000.0000	11000.0000	12000.0000	11000.0000	12000.0000	12000.0000	10000.0000	10000.0000
TDS	9400.0000	9900.0000	9000.0000	9200.0000	9600.0000	9000.0000	9700.0000	9400.0000
TSS	86.0000	290.0000	56.0000	43.0000	37.0000	35.0000	21.0000	23.0000
SULFATE	1600.0000	1600.0000	1600.0000	1600.0000	1600.0000	1700.0000	1900.0000	1800.0000
ARSENIC	< .0040	.0160	< .0040	< .0040	< .0040	< .0040	< .0020	< .0020
BORON	110.0000	180.0000	140.0000	130.0000	190.0000	110.0000	190.0000	200.0000
CALCIUM	1600.0000	1700.0000	1600.0000	1700.0000	1600.0000	1600.0000	1500.0000	1400.0000
LEAD	< .0100	.0230	< .0100	< .0100	< .0100	< .0100	< .0100	< .0100
MAGNESIUM	560.0000	620.0000	660.0000	690.0000	700.0000	730.0000	680.0000	670.0000
MERCURY	< .0002	.0002	< .0002	< .0002	< .0002	< .0002	< .0002	< .0002
SELENIUM	.1700	.1600	.1600	.1900	.1900	.2000	.1500	.0250
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	77.0000	71.0000	81.0000	81.0000	82.0000	87.0000	75.0000	69.0000
TOTAL ELEM	6747.1842	7371.1992	7281.1742	7501.2042	7572.2042	7527.2142	7145.1622	6739.0372

POND H UNDERDRAIN

WELL DESIG	UDH	UDH	UDH	UDH	UDH	UDH	UDH	UDH
DATE	770830.0000	770901.0000	770902.0000	770906.0000	770912.0000	770926.0000	771004.0000	771011.0000
REC NO.	11800.0000	11820.0000	11840.0000	11860.0000	11880.0000	11900.0000	11920.0000	11940.0000
PH	7.1000	7.1000	7.1000	7.3000	7.5000	7.3000	7.5000	7.8000
ALKALINITY	54.0000	57.0000	50.0000	65.0000	69.0000	86.0000	92.0000	100.0000
CHLORIDE	2300.0000	2200.0000	2300.0000	2100.0000	2200.0000	1800.0000	1800.0000	1900.0000
COD	140.0000	76.0000	120.0000	74.0000	110.0000	110.0000	90.0000	90.0000
COND	9300.0000	9100.0000	9000.0000	8700.0000	8600.0000	7900.0000	8000.0000	7800.0000
TDS	8900.0000	8700.0000	7400.0000	7200.0000	7100.0000	6700.0000	6700.0000	6600.0000
TSS	18.0000	20.0000	19.0000	17.0000	15.0000	14.0000	18.0000	15.0000
SULFATE	1900.0000	1800.0000	1800.0000	1800.0000	1800.0000	1700.0000	1800.0000	1700.0000
ARSENIC	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020	< .0020
BORON	180.0000	80.0000	93.0000	110.0000	97.0000	86.0000	98.0000	86.0000
CALCIUM	1300.0000	1300.0000	1200.0000	1300.0000	1100.0000	1200.0000	1200.0000	1100.0000
LEAD	< .0100	< .0100	< .0100	< .0100	< .0100	< .0100	< .0100	< .0100
MAGNESIUM	600.0000	580.0000	620.0000	540.0000	530.0000	470.0000	450.0000	450.0000
MERCURY	< .0002	< .0002	< .0002	< .0002	< .0002	0.0000	< .0002	< .0002
SELENIUM	.1400	.1500	.1800	.1100	.1400	.0320	.0740	.0740
SULFITE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
SODIUM	50.0000	50.0000	37.0000	36.0000	36.0000	34.0000	34.0000	35.0000
TOTAL ELEM	6330.1522	6010.1622	6050.1922	5886.1222	5763.1522	5290.0440	5382.0862	5271.0862

```
POND H UNDERDRAIN

WELL DESIG         UDH          UDH          UDH          UDH          UDH
DATE        771104.0000  771122.0000  780316.0000  780511.0000  780628.0000
REC NO.      11960.0000   11980.0000   12000.0000   12020.0000   12040.0000
PH               7.8000       7.4000       0.0000       7.5000       7.6000
ALKALINITY     120.0000     140.0000       0.0000     260.0000     180.0000
CHLORIDE      2000.0000    1900.0000       0.0000    2100.0000     810.0000
COD             90.0000      84.0000      29.0000      33.0000       9.0000
COND          7800.0000    7600.0000       0.0000    4900.0000    4100.0000
TDS           7100.0000    6700.0000       0.0000    3700.0000    3500.0000
TSS             29.0000      11.0000       0.0000     130.0000     720.0000
SULFATE       1800.0000    1800.0000       0.0000    1200.0000    1700.0000
ARSENIC    <      .0040        .0020        .0040        .0060        .0060
BORON           88.0000     120.0000       0.0000      47.0000      22.0000
CALCIUM       1400.0000    1000.0000     490.0000     690.0000     680.0000
LEAD       <      .0100        .0100 <      .0100        .0320        .0300
MAGNESIUM      510.0000     440.0000      23.0000     320.0000     270.0000
MERCURY    <      .0002        .0002 <      .0002        .0014        .0004
SELENIUM          .0410        .0230        .0090        .0140        .0100
SULFITE          0.0000       0.0000       0.0000       0.0000       0.0000
SODIUM          44.0000      60.0000      46.0000      49.0000      44.0000
TOTAL ELEM    5842.0552    5320.0352     559.0232    4406.0534    3526.0464


POND H UNDERDRAIN   --- AEROSPACE ---

WELL DESIG         UDH          UDH          UDH          UDH          UDH
DATE        770505.0000  771115.0000  771122.0000  780309.0000  780316.0000
REC NO.      12060.0000   12080.0000   12100.0000   12120.0000   12140.0000
PH               7.6100       7.6000       7.2100       7.7000       7.8200
ALKALINITY     128.0000     123.0000     140.0000     279.0000     154.0000
CHLORIDE       105.0000    1500.0000    1750.0000    1350.0000     240.0000
COD              0.0000       0.0000       0.0000       0.0000       0.0000
COND           610.0000    7140.0000    6760.0000    3600.0000    1520.0000
TDS            418.0000    6044.0000    5690.0000    2928.0000    1198.0000
TSS              0.0000       0.0000       0.0000       0.0000       0.0000
SULFATE        147.0000    2000.0000    1625.0000    1025.0000     440.0000
ARSENIC          0.0000 <      .0100 <      .0100        .0120       0.0000
BORON      <      .0500      60.0000      80.0000      36.0000       1.2000
CALCIUM         53.0000    1070.0000    1040.0000     490.0000     140.0000
LEAD             0.0000        .2100        .1900        .6000       0.0000
MAGNESIUM       12.3000     530.0000     500.0000     298.0000      41.0000
MERCURY          0.0000        .0030        .0050        .0017       0.0000
SELENIUM         0.0000        .0020        .0170        .0003       0.0000
SULFITE          0.0000       0.0000       0.0000       0.0000       0.0000
SODIUM          70.0000      52.0000      47.0000      55.0000      85.0000
TOTAL ELEM     387.3500    5212.2250    5042.2220    3254.6140     947.2000
```

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POND H GROUND WELL 1

WELL DESIG           GWH1          GWH1          GWH1          GWH1          GWH1          GWH1          GWH1          GWH1
DATE          770505.0000   770707.0000   770926.0000   771104.0000   771216.0000   780316.0000   780511.0000   780628.0000
REC NO.        12160.0000    12180.0000    12200.0000    12220.0000    12240.0000    12260.0000    12280.0000    12300.0000
PH                 6.6000        7.4000        7.7000        7.5000        7.0000        6.9000        7.0000        7.2000
ALKALINITY       130.0000      100.0000      120.0000      110.0000      110.0000       13.0000      100.0000       72.0000
CHLORIDE          38.0000       18.0000       15.0000       16.0000       14.0000       94.0000       72.0000       64.0000
COD              110.0000        8.0000       32.0000        3.0000        0.0000        3.0000        5.0000        2.0000
COND             440.0000      370.0000      460.0000      430.0000      400.0000      590.0000      480.0000      370.0000
TDS              310.0000      290.0000      440.0000      320.0000      330.0000      360.0000      390.0000      360.0000
TSS              230.0000       40.0000     1600.0000      590.0000     2500.0000      810.0000     1000.0000     2100.0000
SULFATE           58.0000       79.0000       91.0000       87.0000       68.0000       19.0000       30.0000       15.0000
ARSENIC             .0070 <       .0020         .0220         .0040 <       .0020 <       .0020         .0110         .0080
BORON               .1700         .0200         .0600         .0400         .0500         .1000         .1300         .1000
CALCIUM           30.0000       36.0000       48.0000       46.0000       36.0000       33.0000       37.0000       28.0000
LEAD                .0150         .0100         .0600         .0340         .0800 <       .0100         .0180 <       .0100
MAGNESIUM         14.0000       11.0000       16.0000       13.0000       15.0000       10.0000       12.0000        9.3000
MERCURY    <        .0002 <       .0002         .0004         .0004         .0007 <       .0002 <       .0002 <       .0002
SELENIUM            .0040         .0010 <       .0020         .0020 <       .0020 <       .0020         .0010 <       .0010
SULFITE            0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000        0.0000
SODIUM            45.0000       33.0000       36.0000       36.0000       34.0000       34.0000       47.0000       37.0000
TOTAL ELEM       185.1962      177.0332      206.1444      198.0804      167.1347      190.1142      198.1602      153.4192


POND H GROUND WELL 1--- AEROSPACE ---

WELL DESIG           GWH1          GWH1          GWH1
DATE          770505.0000   780309.0000   780316.0000
REC NO.        12320.0000    12340.0000    12360.0000
PH                 6.8100        8.1100        8.1400
ALKALINITY       133.0000       92.0000      109.0000
CHLORIDE          82.0000       30.0000       36.0000
COD                0.0000        0.0000        0.0000
COND             420.0000      372.0000      382.0000
TDS              296.0000      316.0000      288.0000
TSS                0.0000        0.0000        0.0000
SULFATE           58.0000       71.0000       75.0000
ARSENIC             .0040         .0080        0.0000
BORON      <        .0500 <       .5000 <       .5000
CALCIUM           35.0000       26.0000       23.0000
LEAD                .0550         .1600        0.0000
MAGNESIUM         11.2000       12.0000       12.0000
MERCURY    <        .0001         .0008        0.0000
SELENIUM            .0006         .0003        0.0000
SULFITE            0.0000        0.0000        0.0000
SODIUM            45.0000       35.0000       32.0000
TOTAL ELEM       231.3097      174.6691      178.5000
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```
POND H GROUND WELL 2

WELL DESIG        GWH2        GWH2        GWH2        GWH2        GWH2        GWH2
DATE        760914.0000 770505.0000 771216.0000 780316.0000 780511.0000 780628.0000
REC NO.      12380.0000  12400.0000  12420.0000  12440.0000  12460.0000  12480.0000
PH               7.1000      6.6000      6.9000      6.7000      6.6000      7.3000
ALKALINITY     170.0000    150.0000    120.0000     68.0000    120.0000     60.0000
CHLORIDE        98.0000     82.0000     76.0000     88.0000     98.0000    100.0000
COD             30.0000      9.0000     42.0000      8.0000      3.0000      5.0000
COND           590.0000    550.0000    570.0000    640.0000    550.0000    470.0000
TDS            400.0000    370.0000    450.0000    400.0000    350.0000    320.0000
TSS             71.0000     91.0000   4200.0000    940.0000   4800.0000   3900.0000
SULFATE         39.0000     48.0000 <   20.0000     14.0000 <    1.0000      9.0000
ARSENIC     <     .0050       .0040       .0020 <     .0020       .0210 <     .0040
BORON             .1400       .2000       .0800       .2100       .0800       .1800
CALCIUM         72.0000     39.0000     35.0000     34.0000     48.0000     30.0000
LEAD              .0480       .0650       .1700       .0330       .0550       .0560
MAGNESIUM       22.0000     14.0000     19.0000     12.0000     21.0000     13.0000
MERCURY     <     .0002 <     .0002       .0005 <     .0002       .0006       .0010
SELENIUM    <     .0010       .0020       .0020 <     .0020 <     .0010       .0020
SULFITE          0.0000      0.0000      0.0000      0.0000      0.0000      0.0000
SODIUM           4.5000     70.0000     48.0000     43.0000     66.0000     36.0000
TOTAL ELEM     235.6942    253.2712    198.2545    191.2472    234.1576    188.2430
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POND H GROUND WELL 2--- AEROSPACE ---

WELL DESIG        GWH2        GWH2        GWH2
DATE        770505.0000 780309.0000 780316.0000
REC NO.      12500.0000  12520.0000  12540.0000
PH               7.3000      8.0300      8.2900
ALKALINITY     152.0000    140.0000    122.0000
CHLORIDE       110.0000    154.0000    125.0000
COD              0.0000      0.0000      0.0000
COND           540.0000    478.0000    472.0000
TDS            346.0000    316.0000    289.0000
TSS              0.0000      0.0000      0.0000
SULFATE         45.0000     12.0000      9.0000
ARSENIC     <     .0010       .0000      0.0000
BORON             .0500 <     .5000      1.4000
CALCIUM         39.0000     33.0000     28.0000
LEAD              .0400       .2000      0.0000
MAGNESIUM       12.2000     16.0000     14.0000
MERCURY     <     .0001       .0007      0.0000
SELENIUM    <     .0006       .0001      0.0000
SULFITE          0.0000      0.0000      0.0000
SODIUM          65.0000     52.0000     48.0000
TOTAL ELEM     271.2917    267.7088    225.4000
```

APPENDIX B

METHODS USED TO DETERMINE CHEMICAL AND PHYSICAL CHARACTERISTICS OF FGD SLUDGES

B.1 METHODS OF CHEMICAL ANALYSIS USED BY AEROSPACE

This appendix describes the analytical techniques used by The Aerospace Corporation to determine the concentrations of constituents in the flue gas desulfurization (FGD) sludges and pond water samples.* The constituents present in the liquors and water samples are divided into the following: major chemical species (calcium, sulfate, and chloride), trace metal species, and additional chemical species. Other water quality tests are also described.

Consideration was given to the range of concentration of the constituents and to the corresponding costs of the analyses to obtain data having high precision and high accuracy.†

B.1.1 Major Chemical Species

Calcium Determination

Atomic absorption spectrophotometry is presently used for calcium analyses. Results for solutions analyzed by this method were in agreement with those obtained by an oxalate titrimetric method to within 10%.

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*The methods used by TVA are given in:
Methods for Chemical Analysis of Water and Wastes, Second Edition, Methods Development and Quality Assurance Research Laboratory, National Energy Research Center, Cincinnati (1974).

Standard Methods for the Examination of Water and Wastewater, Thirteenth Edition, American Public Health Association, New York.

†Precision is defined as the relationship between a measured value and the statistical mean of measured values, and accuracy is the relationship between the true value and the mean measured value.

Sulfate Determination

Standard nephelometry techniques were used for this analysis. A barium sulfate precipitate was formed by the reaction of the sulfate ion with a barium chloranilate reagent. The resulting turbidity was determined by a spectrophotometer and compared to a curve prepared from standard sulfate solutions. Although multiple dilutions are necessary to bring the concentration to a range of optimum reliability, the error is less than 10%.

Chloride Determination

A specific ion electrode was used to determine the concentration of chloride ions. This method has a precision of about 1% and an accuracy of about 5%. Comparisons were made with results of titrations with silver nitrate. The chloride concentrations, measured with the electrode (1000 to 5000 ppm), in each case differed from the corresponding titration data by less than 5%.

B.1.2 Trace Metal Species

Atomic absorption spectrophotometry was used for analyses of the following elements: aluminum, antimony, arsenic, cadmium, chromium, copper, cobalt, iron, manganese, mercury, molybdenum, nickel, lead, selenium, silicon, silver, tin, vanadium, and zinc. Results were verified by analyzing National Bureau of Standards (NBS) data. Precision and accuracy are dependent upon the means of activation, the specific element, its relative concentration, and the extent of interference by other elements and matrix effects. The precision and accuracy of the measurements of concentrations of all elements that exceed water quality reuse criteria ranged between 5 and 20%. However, the precision, with furnace activation, of trace metals occurring at very low levels is probably no better than 50%.

Mercury was also determined using this technique; however, the mercury was reduced to the elemental state with stannous chloride, and the absorption of the resulting mercury vapor was measured. This method has a precision of about 20% and an accuracy of about 50%.

B.1.3 Additional Chemical Species

Sodium Determination

Atomic absorption spectrophotometry or flame photometry was used to determine sodium ion concentrations, depending on whether the concentrations were relatively low or high. Errors are typically less than 10%.

Sulfite Determination

Total sulfite was determined using a specific ion electrode, and no significant interferences were observed. The oxidation of the sulfite ion to sulfate is a very rapid reaction. Scrubber liquor protected from the atmosphere typically shows sulfite concentrations of several hundred milligrams per liter; however, a brief atmospheric exposure causes oxidation and reduces these concentrations by one or more orders of magnitude. The reported sulfite measurements were for samples analyzed immediately upon arrival in the laboratory. No specific action was taken to inhibit oxidation other than to ensure that the samples were transported to the analytical laboratory in sealed containers. The exposure to air during sampling, filtering, and measuring, however, resulted in the reduced sulfite concentrations reported.

Phosphate Determination

The phosphate analysis was determined by spectrophotometry methods, using ammonium molybdate to form the molybdenum blue complex.

Nitrogen Determination

Total nitrogen was determined by the Kjeldahl method, which reduces all nitrogen to ammonia with sodium thiosulfate. The ammonia was then distilled and the amount determined by titration. This method has a precision of about 10%, and accuracy at the levels of the concentrations determined is about 25%.

Fluoride Determination

The fluoride ion was determined by the specific ion electrode using a Beckman Model 4500 digital pH meter. There were no significant interferences. This method has a precision of about 5%, and accuracy of 20% is attainable at the low levels measured.

Boron Determination

Boron was determined spectrophotometrically with the Hach DR2 using the Carmine method.

Magnesium Determination

Magnesium was determined by atomic absorption spectrophotometry in the same manner as were the trace metals.

B.1.4 Other Water Quality Tests

Chemical Oxygen Demand

Chemical oxygen demand was determined by reacting the organics and sulfites present with potassium dichromate and measuring the reduced chromium by spectrophotometry. While a precision of 25% is attainable, accuracy depends on the same history (i.e., degree of exposure to atmospheric oxygen) and is about 100% for routine analysis.

Total Alkalinity

Total alkalinity was determined by titrating a 25-mℓ sample with standard acid to a pH of 4.0. Total alkalinity is expressed as milligrams per liter calcium carbonate, but is actually a determination of the buffering capacity of the liquor due to a number of weak acid species (i.e., carbonate, sulfite, borate, arsenite, selenite, and silicate). Precision is about 5%, and accuracy is estimated to be about 25%.

Total Dissolved Solids (TDS) Determination

The TDS were determined gravimetrically by evaporating a 25-mℓ sample to a constant weight overnight in a tared weighing bottle at a temperature of about 180°C. Precision is about 2%, and accuracy is about 5%.

Total Conductance Determination

This measurement, which was made with a General Radio impedance bridge, Type 1650A, gave an estimate of the total ionic species in the sample. Precision is about 1%, and accuracy is estimated to be about 2%.

pH Determination

This parameter was measured with a Beckman Model 4500 digital pH meter to a precision of 0.005 pH units and an accuracy of 0.01 pH units.

Analytical Methods Applicable to Sludge Solids

Sludge solids were analyzed for calcium, sulfate, sulfite, and carbonate in addition to total solids and inert material (fly ash).

Total calcium was determined by atomic absorption spectrophotometry after the sample had been dissolved in hydrochloric acid.

Sulfate was determined gravimetrically, taking a 0.25-gram sample which was dissolved in hydrochloric acid. The solution was filtered, and barium chloride was added to the hot filtrate to precipitate barium sulfate. This was filtered off through a tared Gooch crucible with a glass filter pad. It was then dried and ignited at 800°C, cooled, and weighed.

Sulfite was determined volumetrically. A 0.5-gram sample was carefully acidified, using phenolphthalein indicator, then titrated directly with standard iodine using starch indicator.

Carbonate was determined by a gravimetric method, after evolution as CO_2, along with SO_2, by acidifying a 0.5-gram sample in a tared flask. The flask was warmed gently to expel all gases, cooled, and weighed. The weight decrease represents $CO_2 + SO_2$ and must be corrected for the SO_2 content determined by iodometric titration.

B.2 TESTING METHODS USED TO DETERMINE PHYSICAL CHARACTERISTICS OF TREATED SLUDGE

The physical testing of sludge material is patterned after the American Society for Testing Materials (ASTM) standards as indicated. Deviations from the recommended procedures, which are described below, occurred because of the dissimilarities of the sludge material and soil properties for which the ASTM standards directly apply.

B.2.1 Unconfined Compressive Strengths

Rectangular samples were cut from the interior of the Shelby tube sludge cores for unconfined compressive strength measurements (in accordance with ASTM Designation D 2166-66, "Standard Methods of Test for Unconfined Compressive Strength of Cohesive Soil"). Typically, the samples were about 1 in.^{2} in cross-sectional area and about 2 in. in height. After measurement of dimensions, the samples were weighed and placed in a vacuum oven at approximately 60°C for drying to constant weight. Compressive strengths were measured on the unconfined samples, both in the as-received condition of the cores and after drying, using an Instron testing machine to apply a compressive load at a constant rate of 0.02 in./min. Unconfined compressive strength is taken as the maximum load attained per unit area. The applied loads were recorded continuously until structural failures were obtained.

B.2.2 Modified California Bearing Ratio (Load-Bearing Strength)

Load-bearing strengths were measured for sludge core samples, using a method substantively similar to the standard bearing ratio test for compacted soils (ASTM Designation D 1883-73). A 0.95-cm-diam (3/8-in.) rod was forced into the sludge core samples at a constant rate of 0.25 cm/min (0.1 in./min) with an Instron loading machine. Penetration loads were recorded continuously to a maximum penetration depth of 2.54 cm (1 in.). The cylindrical core sample container was sufficiently large, 7-cm (2.7-in.) diam by 10-cm (4-in.) depth, that edge and bottom effects were negligible. Tests were also made with 1.27-cm (0.5-in.) and 2.54-cm (1-in.) diam rods which produced the same load-penetration curves for all three rods and confirmed that rod size was not a variable in these measurements.

B.2.3 Ultimate Bearing Capacity

Ultimate bearing capacity is a field measurement taken with a penetrometer (Soiltest, Inc., Model CN-988), using a No. 1 probe having a cross-sectional area of 0.33 in^2. With a maximum depth range of 6 in., the penetrometer is manually pushed into the sludge material, and the maximum load per unit area that can be reacted by the material is taken as the ultimate bearing capacity.

B.2.4 Permeability

Constant head permeability tests (for example, ASTM Designation D 2434-68, "Standard Method of Test for Permeability of Granular Soils - Constant Head") and leaching tests were made on monolithic samples of 4 to 6 in. in height. Five-in.-diam. sections of treated sludge taken from the coring tube were sealed with silicone elastomer in plastic tubes. After addition of a 6-in. column of water above the sludge, the tubes were pressurized with nitrogen to 5 psi to accelerate the tests if necessary. The rate of permeation was measured and converted to permeability coefficients, and leachate samples were collected periodically. The pH and TDS were measured immediately, and analyses for the major constituents were made according to the procedures described under chemical analyses.

B.2.5 Wet Bulk Density, Percent Solids

Samples were cut from Shelby tube cores to about 1 in.^{2} in a cross-sectioned area about 2 in. in height. After measurement of dimensions, the samples were weighed and placed in a vacuum oven at approximately 60°C for drying to constant weight. The wet bulk density was taken as the material weight divided by the volume in the as-received condition; percent solids were taken as weight of the material minus the weight of the water (found by drying the sample), divided by the weight of the material in the as-received condition.

B.3 TESTING PROCEDURES FOR SOIL ANALYSIS

Approximately 100 grams of each sample were freeze-dried to constant weight and finely ground in a porcelain ball mill.

B.3.1 Sulfate and Chloride Analysis

An accurately weighed aliquot of about 10 grams of the freeze-dried powder was leached by 100 mℓ of boiling distilled water for one hour. The resultant suspension was flocculated with KH_2PO_4 and filtered through Whatman GF/F glass fiber filters. One-half of the leachate was titrated with $AgNO_3$ for chloride, and one-half was precipitated with $BaSO_4$ for sulfate. Both Cl and SO_4 were near the limit of detection in most of the samples.

B.3.2 Elemental Analysis

An accurately weighed aliquot of about 5 grams of the freeze-dried powder was leached for one hour with boiling concentrated nitric acid. The acid was evaporated to near dryness, and the sample was washed through Whatman 52 filter paper with 1N nitric acid. The volume was adjusted to 50 mℓ, and Fe, Ca, Cd, As, Se, and Pb were determined by atomic absorption spectrometry. As and Pb were determined by flameless AA (HGA-2100), whereas Fe, Ca, and Cd were determined in the flame.

Mercury was determined in an aliquot of the wet sediment so as to avoid possible loss during freeze-drying and was leached with concentrated HNO_3 and $KMnO_4$ in vessels with air condensers to avoid loss during digestion. Concentrations were converted to dry weight using the water content data after the cold vapor AA determination.

B.3.3 Results

The results of the analysis are given in Table B-1.

TABLE B-1. SUMMARY SHEET, AEROSPACE SOIL SAMPLES, MARCH 1977 CORING OF TVA/SHAWNEE PONDS[a]

Sample I. D. Number	Water % (wet sediment)	Concentration in Dry Sediment								
		SO_4, %	Cl, %	Fe, %	Ca, %	Cd, ppm	Pb, ppm	As, ppm	Se, ppm	Hg, ppm
Pond C, 1 in. below surface	16.7	0.014	0.035	1.69	0.18	<0.05	9.5	11.4	<5	0.014
Pond C, 3 in. below surface	17.5	0.015	0.043	1.72	0.16	<0.05	9.6	12.3	<5	0.023
Pond C, 9 in. below surface	17.7	0.015	0.028	1.78	0.15	<0.05	9.4	13.2	<5	0.020
Pond D, 1 in. below surface	21.5	0.027	0.013	1.06	0.24	<0.05	8.5	7.9	<5	0.027
Pond D, 3 in. below surface	18.7	0.037	0.013	1.06	0.27	<0.05	8.6	6.2	<5	0.027
Pond D, 9 in. below surface	18.2	0.037	0.023	1.26	0.24	<0.05	8.8	9.4	<5	0.035
Pond E, 1 in. below surface	19.0	0.062	0.008	1.57	0.22	<0.05	8.6	14.1	<5	0.033
Pond E, 3 in. below surface	20.0	0.046	0.009	2.07	0.22	<0.05	12.3	16.0	<5	0.024
Pond E, 9 in. below surface	20.0	0.028	0.014	1.80	0.20	<0.05	10.8	10.4	<5	0.033
Location 1, 6 ft. 1 in. below surface	15.7	0.005	0.005	1.86	0.04	<0.05	8.4	10.2	<5	0.010
Location 1, 6 ft. 3 in. below surface	14.8	<0.001	0.007	1.75	0.05	<0.05	9.4	8.9	<5	0.019
Location 1, 6 ft. 9 in. below surface	13.0	0.010	0.009	1.27	0.06	<0.05	8.4	7.7	<5	0.005
Typical Soils[b]	--	--	--	1-2	0.1-0.6	<1	15-25	5-10	<0.5	0.03-0.06

[a] Analysis by B.J. Presley, Texas A&M (1977).

[b] Connor and Schacklette, U.S.G.S. Professional Paper 574-F (1975).